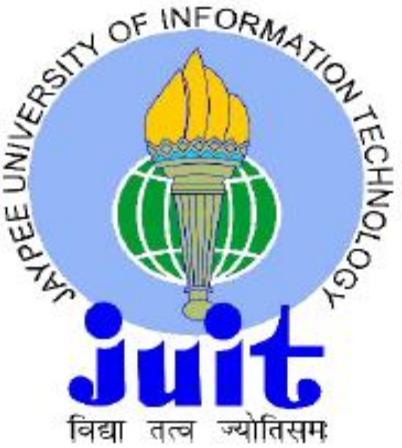
EIA ON 2 LANING TO 4 LANING OF NH-22 FROM SOLAN TO SHIMLA



Project Report submitted in partial fulfillment of the degree of
Bachelor of Technology
In
Civil Engineering

Under the Supervision of
Mr. Mudit Mishra

By

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Above all, we express our indebtedness to the "ALMIGHTY" for all his blessing and kindness.

Name of Student	**Signature of student**
Shekhar Agarwaal	
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CERTIFICATE

This is to certify that project report entitled "**EIA ON 2 LANING TO 4 LANING OF NH-22 FROM SOLAN TO SHIMLA**", submitted by **Sachin Thakur (101643) and Shekhar Agarwaal (101695)** in partial fulfillment for the award of degree of Bachelor of Technology in Civil Engineering to Jaypee University of Information Technology, Waknaghat, Solan has been carried out under my supervision.

This work has not been submitted partially or fully to any other University or Institute for the award of this or any other degree or diploma.

Signature of Supervisor: ……

Name of Supervisor: ……

Designation: ……....

Date: ……

ABSTRACT

The Environmental Impact Assessment (EIA) is a systematic investigation of both positive and negative impacts on the physical, biological socioeconomic environment, which would be caused or induced due to a proposed developmental project. EIA helps to develop environmental friendly projects and seeks to reduce environmental degradation caused by developmental activities. It also provides a plan to reduce the negative environmental effects of proposed development project through alternative approaches, design modifications and remedial measures .Highway construction is a major activity of economic development especially in developing countries. Road development is major source of damage to the environment, including ecological destabilization, habitat disturbance and damage to flora and fauna. The present report analyses the environmental impacts likely to occur due to the proposed upgradation of a 50 km stretch of NH-22 from Solan to Shimla. The study concentrates on the environment impact assessment of the project in the light of the existing situation at the site. The parameters covered in study are Socio-Economic, Biological, Air (Dust), Water, Noise, Ecological & Soil. Samples of air, water & soil were taken to analyze their present conditions. Data was also collected from various Government offices like the forest department and National Highway Authority of India.Highway capacity was analyzed and it was observed that the present two lane highway is insufficient to handle the current traffic volume so the section requires four laning immediately to accommodate more traffic. After analyzing different parameters and discussing the probable impacts suggestions are made regarding the mitigation measures that can be taken at different stages in order to reduce the environmental impacts.

REVIEW OF LITERATURE

Environmental Impact Assessment is an important tool for decision making regarding projects, developments and programmes. By analyzing the baseline information and predicting the impacts, alternative processes are suggested so that the most environmentally suitable options are adopted. The literature review addresses various studies made to review the EIA process & aims to analyze its effectiveness and suggesting measures to overcome the shortcomings. The review also aims to study new methodologies that can be incorporated to make the process more effective and less time consuming.

The use of a multi-criteria technique, namely the analytic hierarchy process (AHP) was proposed, for the EIA by **Ramanathan (2001).** AHP has the flexibility to combine quantitative and qualitative factors, to handle different groups of actors, to combine the opinions expressed by many experts, and can help in stakeholder analysis. The use of AHP was illustrated for a case study involving socio- economic impact assessment. In the case study, AHP was used for capturing the perceptions of stakeholders on the relative severity of different socio-economic impacts, which will help the authorities in prioritizing their environmental management plan, and can also help in allocating the budget available for mitigating adverse socio-economic impacts. Thus several advantages of using the (AHP) as a tool while carrying out an environmental impact assessment was highlighted. It was concluded that AHP can be a useful tool for systematically analyzing the opinions of several groups of experts belonging to diverse fields in an environmental impact assessment study.

Paliwal (2006) evaluated EIA process in India through Strength, Weakness, Opportunity and Threat (SWOT) analysis & she suggested that in India Environmental Impact Assessment (EIA) relied on the institutional framework that has a strong supporting legislative, administrative and procedural set-up. Both central and state authorities together are sharing the responsibility of its development and management. The SWOT analysis taken up of the EIA suggested that there are several issues that need to be readdressed. Several constraints, ranging from improper screening and scoping guidelines to ineffective monitoring and post project evaluation were highlighted.The opportunities addressed for improving EIA were increasing public awareness, initiatives of environmental groups, business community, and forward thinking to integrate environmental consideration into plans and policies. Poor governance, rapid economic reforms, and favors to small-scale units were identified some of the foreseen threats to the system. It was mentioned that improved effectiveness would also depend on strength of government agency coordination, integrated decision-making adequate training to various stake holders and supporting infrastructure for purposeful monitoring and enforcement. It was suggested that the EIA system should be regularly revisited for progressive refinement that should not only remove existing constraints but also take care of future challenges. It was further recommended that project level EIA needs immediate attention but efforts should also be targeted to include environmental conservation concerns at policy and planning level. Such initiatives would help in filling up the gaps in coordination between various government authorities involved in planning and execution.

A report on Environmental Impact Assessment (EIA) for the proposed improvements to the Project Road from Chengapalli to Walayar was presented by **Wilber Smith Associates (2008)** to National Highways Authority of India (NHAI) .The report was prepared according to the structure of the EIA Report presented in the EIA Notification, 2006 by Ministry of Environment and Forests, Government of India. The EIA was based on detailed field reconnaissance surveys, inventories and available secondary information. No significant adverse impacts were anticipated on the environment due to the proposed improvements. However, temporary impacts are anticipated on air quality, noise levels, water quality, soil quality, flora & fauna and socio-economic environment of the project area. Further, an increase in ambient noise level is expected along the project road during the operation stage. Proper mitigation measures were proposed in the EMP for mitigating the negative impacts. The environmental monitoring plan and reporting mechanism proposed as part of the EMP will ensure the proper implementation of the EMP.

EIA for nuclear facilities was studied & how environmental, health, social impacts and public inputs have been taken into account was examined. It was observed that there are concerns that are specific to nuclear facilities in addition to generic problems associated with the EIA process for all kinds of projects in India. **Ramana etal. (2010)** observed that some nuclear facilities are exempted from the environmental clearance process. That data regarding radiation baseline levels and future releases is controlled entirely by the nuclear establishment & members of the nuclear establishment take part in almost every level of the environmental clearance procedure thus making the EIA process is of dubious quality. Regarding the public consultation it was observed that the administrative authorities conducting the public hearings are clearly sided with project proponents & ignored the views of locals is .Thus some steps were suggested to improve the situation like: subjecting all facilities, including reprocessing plants to the EIA process , the proposer should be required to go through the public comment process again with revised EIA if an EIA is found to be faulty at the technical or factual levels and setting up an agency , completely independent of the nuclear establishment. It was proposed that Atomic Energy Regulatory Board should be kept outside the administrative and financial purview of the Atomic Energy Commission & steps should be taken to make public participation more meaningful & radiation levels should be measured time to time.

INTRODUCTION OF NH-22 (SOLAN TO SHIMLA)

The Ministry of Road Transport and Highways (MORTH) on behalf of Govt of India engaged in the development of National Highways through the Govt body represented by National Highways Authority to develop the National Highways under NHDP (National Highways Development Programme). As a part of endeavour the National Highways Authority of India has decided to undertake four laning of section from Solan (km 106.000) to Dhalli (km156.507,existing chainage) of NH-22 through Public Private Partnership (PPP) on Design, Build, Finance, Operate and Transfer (the "DBFOT") basis. The project, complementing the NHDP, seeks to connect high-traffic density stretches, state capitals and tourism centres to the NHDP Phase III. The study corridor is the section of NH-22 and lies in the State of Himachal Pradesh connecting to state capital Shimla to Solan and subsequently to Chandigarh and Ambala.

BACKGROUND OF THE PROJECT

Infrastructural development, particularly faster movement and transportation of goods in a country like India, is a guiding factor for economic development. Proper transportation of goods requires comprehensive transport systems and increasing road traffic requires better riding quality of roads and uninterrupted movement. Hence it becomes necessary to develop new roads.

In the recent liberalized economic environment of India, transport system in general and road transport in particular is considered to improve the international competitiveness of exports and attract foreign investments. Considering the above benefits more attention is being given now to road projects by national and multilateral funding agencies. The ongoing ambitious National Highway Development Project (NHDP) of the Government of India and likewise massive expansion of state roads and rural roads are indicative of road sector development in India. Such engineering projects also accompany with attendant human and environmental problems which need to be addressed and integrated to produce sustainable streams of social and economic benefits.

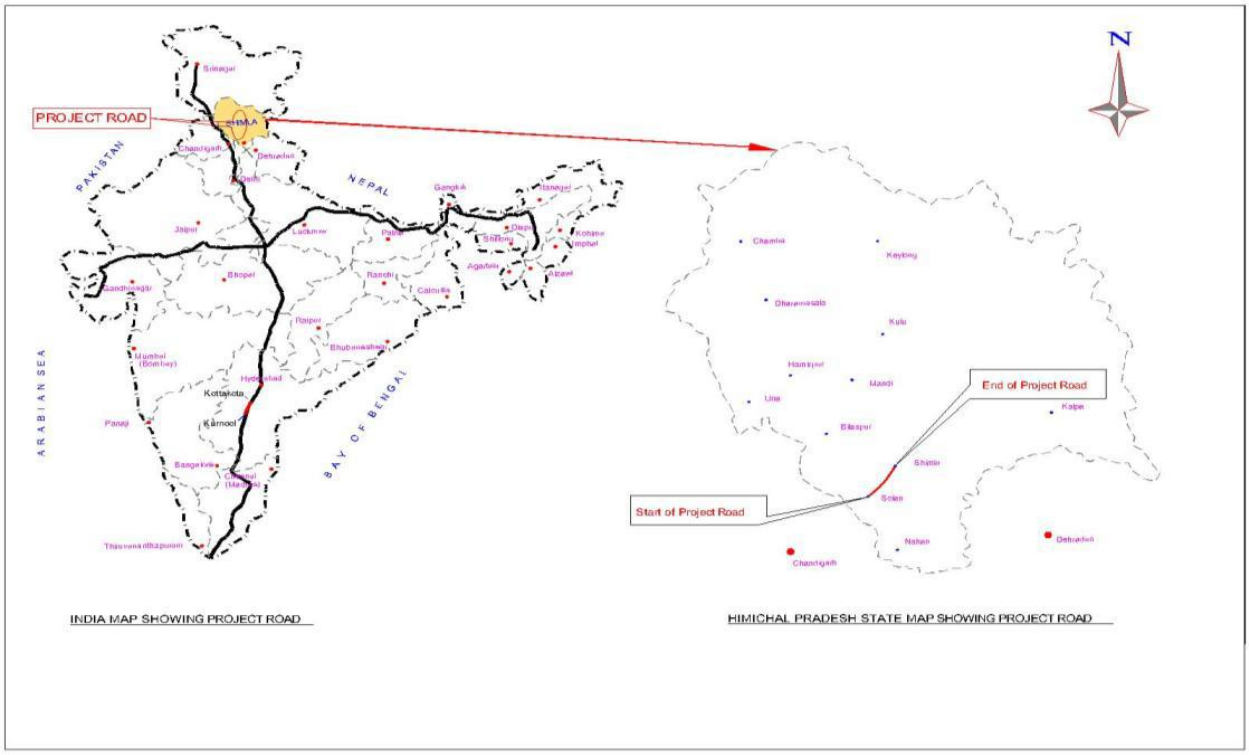
There is a growing recognition that people, communities and institutions are crucial to development outcomes and these social safeguard policies form the basis for social development. This agenda emphasizes a broader view of development, stronger ownership by stakeholders, and wider partnerships among the private sector, civil society and multilateral funding agencies.

Considering the neglect of road infrastructure backlog and growing recognition of its tremendous impact on economic development within the globalizing environment, the Government of India has taken new initiatives in the road sector development and in particular the national highways. Projects in the road sector in India consist largely of upgrading and/or improvements of existing national/state highways and rural access roads.

In the view of the above, National Highways Authority of India (NHAI) has decided to construct the 4 lane highway, covering the section of NH-22 from Solan to Shimla. This section passes through the districts of Solan and Shimla of Himachal Pradesh. The length of the proposed project is 50.507 km. The project road stretch is a part of tourist route and connects the cities of Kalka, Shimla, Parvanoo, Ambala, Chandigarh, etc. Shimla is the capital city of Himachal Pradesh. Solan is an important town of Himachal Pradesh as it has many industries, and bulk trading market of apple. This project road carries a significant heavy traffic to and from Shimla and other parts of the State. There is thus an immediate necessity to widen the existing road

to enhance the economic capability of the area.

Figure 1: Location Map of Project Road



Implementing Agency

The National Highways Authority of India is the implementing agency of the project. The Consultancy services for Preparation of Feasibility-Cum-Preliminary Design for 4 Laning of Solan- Shimla section of NH 22 in the State of Himachal Pradesh to be executed as DBFOT (Toll) Project on DBFOT Pattern under NHDP Phase III have been entrusted to Meinhardt Singapore Pte Ltd.

BENEFITS OF THE PROJECT

The project will have multiple benefits. It will reduce the travel time substantially between Solan and Shimla, the two primary cities of Himachal Pradesh. The proposed alignment also reduces the distance between Solan and Dhalli by about 16.6 km due to planned bypass for Shogi and Shimla. In addition the improved road will provide other benefits like
Fast and safe connectivity resulting in savings in fuel, travel time and total transportation cost to the society;

- Employment opportunity to people;
- Development of local industry, agriculture and handicrafts;
- Development of tourism and pilgrimage;
- Transporting, processing and marketing of agricultural products;
- Reduction in accidents;
- Reduction in pollution;
- Opening up of opportunities for new occupations;

- Better approach to Medical & Educational services and quick transportation of perishable goods like fruits , vegetables and dairy products;
- Improved quality of life for people and so on.

THE DESCRIPTION OF THE NATURE, SIZE & LOCATION OF THE PROJECT ROAD

The project is a linear project aimed to provide faster transport to vehicular traffic. The total length of the project road is 50.507 km. Project road starting point is Solan (Km 106.000) and the termination point is near Dhalli (Km 156.507). The Project road portion from km 106.000 to km 129.007 runs in Solan district and from km 132.230 to End point in Shimla District. The existing road is of two-lane configuration. There are 3 minor bridges and 185 culverts on the road. The proposed project will have 11 major bridges 8 minor bridges and 256 culverts. The project plans to have four tunnels. The road alignment has sharp curves at few locations.
The existing road passes through 6 major settlements, some of which do not have sufficient RoW to be widened to 4-lane facility hence bypass for Kandaghat and Shogi, Shimla and Dhalli have been proposed to avoid these congested settlements and uninterrupted movement of traffic. At such locations realignment has been proposed for geometric improvement and also to protect/ save environmentally sensitive places. The proposed improvement will aim at improving riding quality and journey speed and reducing traffic congestion on the highway. The options of concentric widening and left or right side widening have also been considered for the improvement project so as to utilize the existing right-ofway (RoW) as far as possible and minimize acquisition of additional land. However, land acquisition will be required as the existing ROW is 25 m only.
In addition, 15 number of Bus bays have been proposed at big villages where the frequency of the bus stoppages are more and at all other village locations. Truck lay bye has been proposed at two locations.. Toll plaza has been proposed at one location.

ENVIRONMENTAL IMPACT ASSESSMENT

Objective and Need of Environmental Impact Assessment

Review of the existing legislation, institutions and policies relevant to the Environmental Impact Assessment at the National and State levels has been done and clearance requirements for the project at various stages of the project have been identified. In terms of the provision of Ministry of Environment and Forests (MoEF) 2006 notification, this project will get classified as a category ‘A’ project of the said notification because of the following features of the road:

- The project road is more than 30 km in length;
- The proposed bypasses and the widening along the existing alignment involve substantial acquisition of land; (>20 m) and
- The project road is a National Highway (NH).

Therefore the project will require prior environment clearance for execution.
The objective of environmental impact assessment study is to identify the adverse and positive impacts due to project implementation, suggest avoidance, mitigation and enhancement measures in project design and to prepare Environmental Management Plan (EMP) for pre-construction, construction and operation phases of the project.

Scope of EIA Report

The scope for the environmental impact assessment has been decided based on past experience of consultants of similar projects and Terms of Reference of consultants. The outcome of the environmental screening study carried out by the consultants also helped in finalising the scope for the EIA study. The EIA study being undertaken will meet all requirements of National and State Level statutory undertakers. The EIA Study also complies with the TOR approved by MoEF.

ENVIRONMENTAL REGULATORY FRAME WORK

The Environmental Regulatory Framework in India is controlled by "The Environment (Protection) Act, 1986. Under this Act, Environmental Impact Assessment (EIA) Notification - 2006 has been issued by the Ministry of Environment and Forest (MoEF), Government of India. Under the Environment Protection Act 1986 an Environmental Impact Assessment Notification 2006 has been issued by the Ministry of Environment and Forest for the prior environmental clearance for projects /activities. The activities requiring prior environmental clearance have been listed in Schedule of this Notification.
The clearances and permissions required under existing environmental legislation to implement the Project are summarized below in **Table 1.**

Table 1- CLEARENCES & PERMISSION REQUIRED.

S.No	Description	Authority to Accord Clearance
1	Tree felling and removal from non forest areas	District Level Committee constituted by the State Govt. and chaired by the District Collector, and DFO
2	Setting of hot mix plants, crushers and batching plants	Himachal Pradesh Pollution Control Board
3	License to store HSD and Explosives at Construction camp by the contractors from Chief Controller of Explosives under Petroleum Acts and Rules	Regional office of Chief Controller of Explosives, Nagpur
4	Permission to withdraw water for construction from surface water sources such as canals and rivers	Himachal Irrigation Department
5	Permission to withdraw water for construction from ground	Central Ground Water Board
6	Permission for sand mining from river bed	Department of mining, Govt. of Himachal Pradesh. The Collector of the district will grant short-term mining lease.
7	Establishment of workers camp, equipment and storage yards	Himachal Pradesh Pollution Control Board
8	Storage, handling and transport of hazardous materials	Himachal Pradesh Pollution Control Board

9	Waste water discharge from labor Camps	Himachal Pradesh Pollution Control Board
10	Disposal of bituminous Wastes	Local Civil Body to identify solid waste disposal sites
11	Opening up new Quarries	Department of Commerce and Industries, Govt. of Himachal Pradesh.

PROJECT DESCRIPTION

GENERAL

During the last fifty years rapid development has taken place with increase in volume of traffic. The existing roads are not able to cope up with the increased traffic and there is a need to widen/upgrade this road. Present chapter gives an outlook of the present condition of the project corridor along with the proposed development.

PROJECT LOCATION

Solan and Shimla are two important cities of Himachal Pradesh. Shimla is the capital city of Himachal Pradesh. It was also a summer capital of India during British Raj. The National Highway -22(NH-22) connects these both cities. This highway has importance because it is used extensively by the tourists during the summer and winter months. This project road carries a significant heavy traffic to and from industrial units and during the transportation of apple in September-November months. Widening of this road is needed immediately to cater for future requirements. It is planned to widen this road to 4 lane configurations with geometric improvements for free flow of traffic. The project road passes through two districts namely Solan and Shimla. The proposed widening will lead to adverse and positive impacts on environment. Similar to environment there will be impacts on socio-economic environment also. The project plans to minimize negative socio-economic and environmental impacts. The public consultations are being undertaken to disseminate project information to all stakeholders, especially to the project affected persons and to invite views, comments and suggestions of stakeholders to incorporate in the project design.

NEED AND OBJECTIVE

Improvement of surface connectivity helps to improve the economic and social welfare of any group or social community. Improved road connectivity can reduce travel times and lower the costs of vehicle use even in case of emergencies.
Thus it plays an important role in the sustainable and continual development of the state especially the specific districts. A capacity analysis for project road section has been carried out to define the level of service offer by road under the prevailing roadway and traffic condition.
In order to meet the challenges faced by the existing road suitable options for improvement have been proposed. Widening proposed are eccentric left, eccentric right and concentric as per availability of clear site on the respective sides and in congested places where no suitable RoW is available 1 new bypass and one realignment are proposed in order to save structure, houses, temples at congested locations.

PROJECT INTERVENTION

The project is passing through Solan and Shimla districts, district wise length of the project road is given in table below**.** The existing road passes through 8 major settlements namely Solan, Kandaghat, Waknaghat, Shoghi,Taradevi,Kacchighati, Shimla and Dhalli. Out of these Shoghi, Shimla and Kadaghat do not have sufficient RoW to be widened to 4-lane facility hence bypasss for Shoghi –Shimla Dhalli and Kandaghat have been proposed to avoid these congested settlements and uninterrupted movement of traffic. Details of location of bypasses have been discuss later**.** At other locations realignments have been planned for geometric improvement and also to protect/ save environmentally sensitive features. The proposed improvement will aim at improving riding quality and journey speed and reducing traffic congestion on the highway. The options of concentric widening and left or right side widening will be considered for the improvement of project so as to utilize the existing right –of way (RoW) as far as possible and minimize acquisition of additional land. However, land acquisition will be required through entire stretch as the existing RoW varies between 24 to 25 m.

Figure 2:- Location Map of Project Road

Project location and Alignment on Map

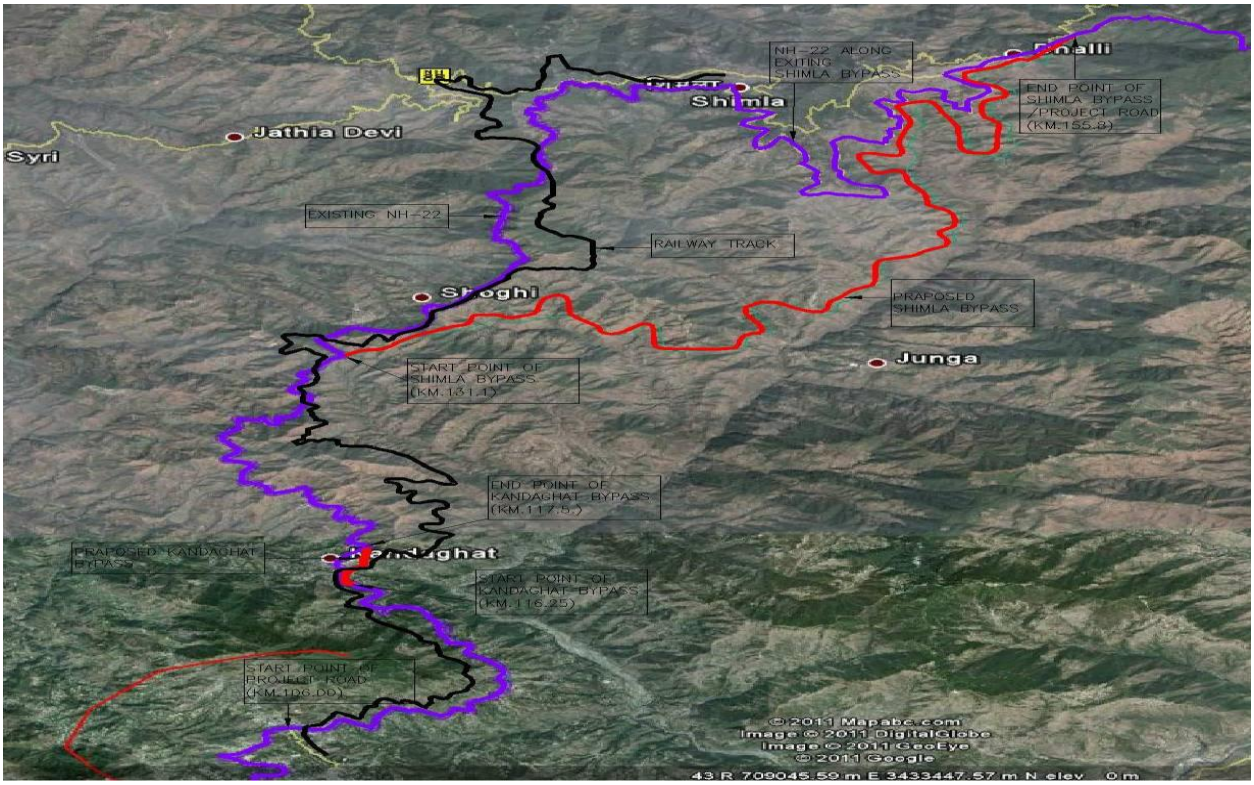


Table 2- DISTRICT WISE LENGTH OF PROJECT ROAD

S.No	Name of District	Length (km)
1	Solan	23.007
2	Shimla	27.500
3	Total	50.507

- # Cost Estimate:

Total cost civil works for the project is estimated at INR 1786 Corers.

Survey:

Figure 3: Condition of the existing Road.

View of Congested Shoghi Town

View of Congested Shimla Town

Kandaghat Town

Major Junction Between NH-22 And NH-88

Road and Railway Line is Passing Side By Side

Blind Curve on existing Road.

Samri Nalla (only perennial surface water source)

DESCRIPTION OF THE ENVIRONMENT

WHAT IS ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

Environmental Impact Assessment is a tool used for decision making regarding projects, developments and programmes such as airport runways. EIA is intended to identify the Environmental, Social and Economic impacts of a proposed development prior to decision-making. This means that it is easy to identify

1. The most environmentally suitable option at an early stage
2. The best practicable environmental option
3. Alternative processes

The project managers can then address these problems in order to avoid or minimize environmental impacts in conjunction with their project planning. This results in the likelihood of the project planning stages running smoother The Environmental Assessment is carried out by the Developer although the task is often carried out by Environmental Consultants. Environmental Assessment is carried out in order to produce an Environmental Statement. The Environmental Statement must include:

- A description of the project: location, design, scale, size etc
- Description of significant effects
- Mitigating Measures
- Summary

THE EIA PROCESS

There are two steps in EIA. The two stages are

Preliminary Assessment: Carried out in the early stages of planning

Detailed Assessment: Carried out during project planning until the project plan is completed and are reported formally as an Environmental Statement.

ENVIRONMENTAL CONSIDERATIONS IN HIGHWAY PROJECTS

Road development can have wide-ranging environmental impacts compared to many other development projects. This is because road extend over long distance and, by promoting rapid communication, they can catalyze dramatic changes in land-use patterns not only in the immediate vicinity but also in the adjacent hinterlands. Road development is very important for the socio-economic development of any region. Development of industry, mining forestry, agriculture, trade and tourism etc. depends to a large extent on the existence of efficient transport network. In order to increase the efficiency of transportation system new roads are being constructed and existing roads being improved.

Road project are generally intended to improve the economic and social well being of people. Increased road capacity and improved pavements can reduce travel time and lower the costs of vehicle use, while increasing access to markets, jobs, education and health services and reducing transport cost for both freight and passengers. For all the 5

positive aspects of roads, they may also have significant negative impacts on nearby communities and natural environment. The environmental problems, which are associated with the highways, strangulate the road system in most of the cases. The most common problems are:

1. Air Pollution
2. Noise Pollution
3. Water pollution
4. Vibration
5. Discharge of effluents on the road sides
6. Wildlife disturbance
7. Deforestation
8. Contamination of soil
9. Setting up of Brick Kilns and other industries along the highways
10. Visual intrusion and degrading of aesthetics
11. Socio economic impacts

1) Air Pollution: Air pollution takes the form of poisonous fumes and smell caused by the emissions from the engine exhaust. The major pollutants are carbon monoxide, oxidizes of nitrogen lead particulars and smoke. Smoke in combination with fog can cause sway, which is hazardous to driving. The hot mix plants which are used in the construction of highways create a large amount of pollution.

2) Water Pollution: A number of factors related to project actions, plans, programmes, and policies affect water quantity and quality directly and indirectly. It is a major task of the EIA exercise to identify such factors and assess their impact on water and aquatic environment. Some of the crucial factors linked with water related impacts on highway projects can be listed as follows:-

- Surface stream discharge
- BOD
- Suspended solids
- Turbidity
- Total dissolved solids
- Phosphorous
- Chlorides
- Ground water quantity and quality
- Erosion
- Sedimentation

3) Socio-Economics: H/R projects can provide beneficial impacts through increased access, which in turn can lead to the building of new industries, hotels, restaurants, resorts and other employment opportunities. However, these secondary developments could have adverse environmental impacts in term of an increased load of pollution. H/R development can have significant effects on communities. H/R projects in urban areas often require displacing or disrupting segments of residential or business communities and may thus isolate certain portions of a community. Certain business may benefit or suffer on account of new roads. Proximity effects such as noise and vibration can change or alter the character of facilities and services and thus must be described / analyzed.

H/R projects can have significant impacts on adjacent land costs. A problem that may occur in the rural areas is unequal distribution of access to markets is caused by poor planning that results in road system bringing a surplus of access to some markets while not meeting the needs of other markets.

4) Ecological Resources:

i. Forestry: The effects of the H/R projects on forestry are primarily caused by the site clearance for the roadbed and right-of-way, improved accessibility leading to encroachments by the people. The forest composition, the types and number of trees to be cut down during the construction, the estimated loss of forest productivity and the estimated impacts of this loss on sub-national and national levels, should be described.

ii. Wild Life: The wild life species likely to be affected by the project should be listed, and those species that are of sub-national/ national/ international significance should be identified. If possible, there should be assessment of the intrinsic value of the wild life resources in the overall national resource context to determine whether alternative routing can be given to preserving wildlife travel routes, especially for such susceptible species as arboreal (tree) animals and deep-forest birds.

5) Noise: Proximity effects such as noise and vibration can change or alter the character of facilities and services and thus must be described / analyzed.

6) Traffic: The transport system including road network has become one of the major factor in the overall progress and instrumental for economic development. This has induced tremendous growth of traffic creating multi related problems for the movement of men and material within the state. Preliminary investigations should be done at the project site in order to formulate the basis of the project study. Traffic surveys are conducted on the project road in order to derive the appropriate design of the road, to identify present and future problems, and to identify solutions.

7) Soil: Soil at and around a construction site may get contaminated by deposition of construction contaminants due to air transport as well as water runoff of construction contaminants .Soil may constitute a sink for pollutants and some of those may accumulate in soil and persists over longer periods of time

METHODOLOGY FOLLOWED

The EIA procedure preceded simultaneously with design of the project road and methodology shown .The important findings of the assessment gave important feedback to the design team, especially in terms of the sensitive receptor utilities /facilities to be impacted and locations of religious properties. It helped modify the designs at locations where impacts had to be avoided and incorporate mitigation measures wherever the impacts were unavoidable due to other constraints. The steps covered in the preparation of EIA are as follows:

Review of Documents; the documents of Rules, Guidelines, Acts of Government of India and Government of Himachal Pradesh, Prototype studies were reviewed.

Reconnaissance Surveys : A team of professionals took the reconnaissance of the site to have a feel of the area and to identify the likely Environment issues associated with the project.

Collection of Secondary Data and Generation of Primary Data : The Secondary data was collected from different sources about components of valued Eco-system like Climate, Physiography, Soil type, Ecology of the area. The gaps in secondary data were filled by generating primary data like Ambient Air Quality, Water Quality, Noise Levels and Surface Hydrology etc

Documentation of Baseline Conditions : Assessment of Potential Impacts; The Potential impacts on Components of Valued Eco System have been assessed based on previous prototype studies, different prediction models and Past Experiences. The predication has been both qualitative and quantitative.

Identification of Mitigation and Enhancement Measures: Analysis of Alternatives; All alternatives were considered and adverse impacts of each alternative were studied before selecting the proposed alignment.

Public Consultations. Preparation of the Environmental Management Plans. Environment Management Programme has been developed suggesting mitigation measures for various impacts on components of Valued Eco Systems to offset the adverse impacts or to mitigate the adverse impacts and bring them to acceptable levels. The monitoring programme specifies the monitoring mechanism, frequency etc. A detailed budget has also beenprepared for implementation of Environment Management and Monitoring Programme.

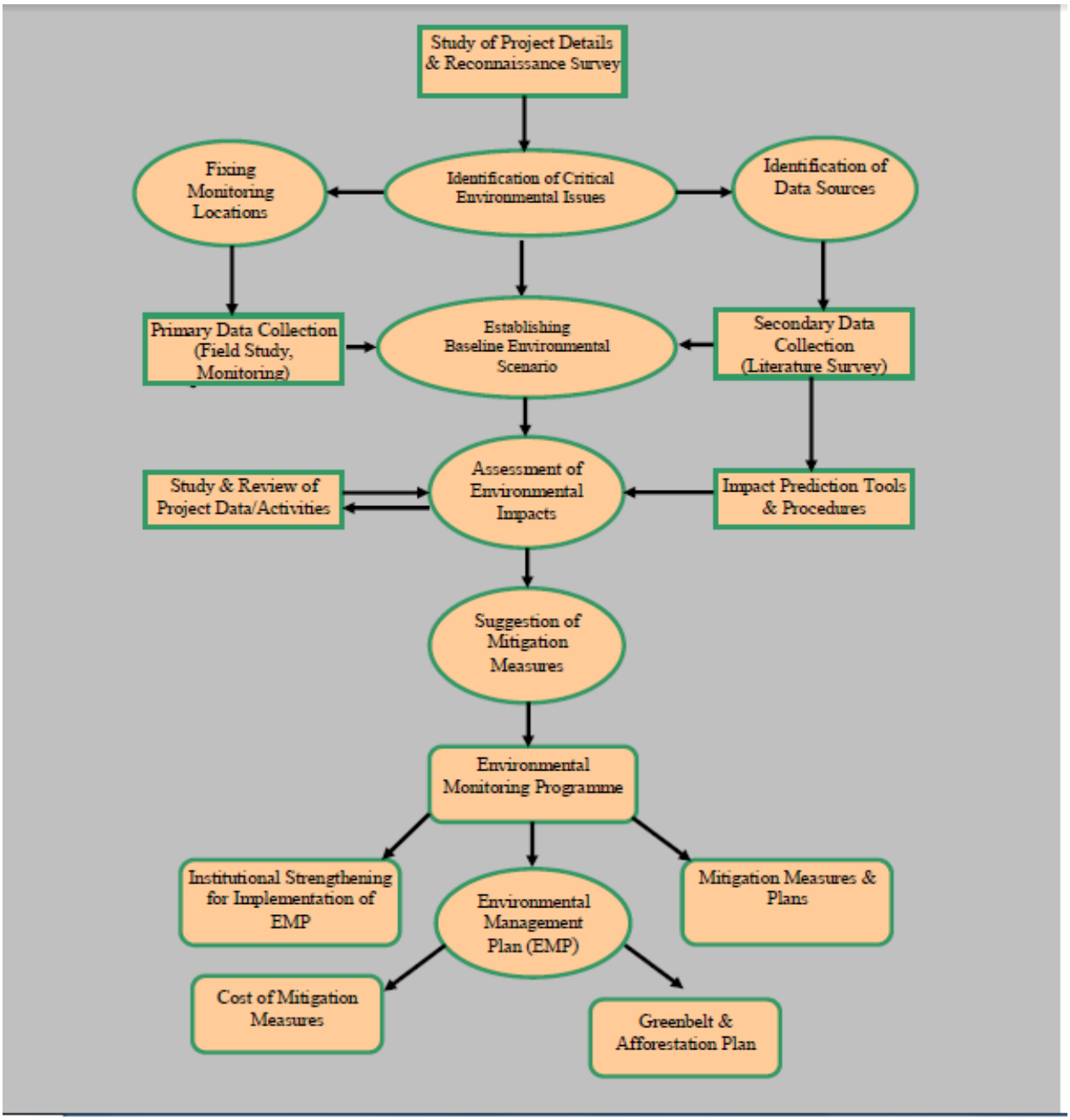


Figure 4 : EIA Methodology

TESTING

Table 3: Ground water quality monitoring

Parameter	SOLAN GW	SHOGHI GW	SHIMLA GW	Limits IS: 10500
pH	7.5	7.8	8.0	6.5-8.5
Colour	Colourless	Colourless	Colourless	
Odour	Odourless	Odourless	Odourless	
Turbidity	0	0	0	5
TDS (mg/l)	200	205	225	500
TSS (mg/l)	1	4	6	
Total Hardness (mg/l)	245	240	265	300
Total Alkalinity (mg/l)	90	85	88	200
Chlorides (mg/l)	48	52	55	250

Table 4: Surface water quality monitoring

Parameter	Samri Nalla (137.500 km)	Limits IS: 10500
pH	7.8	6.5 - 8.5
Colour	Colourless	
Odour	Odourless	
TDS (mg/l)	180	500
TSS (mg/l)	34	
Total Hardness (mg/l)	105	300
Total Alkalinity (mg/l)	43	200
Chlorides (mg/l)	25	250

Conclusion

- The chemical quality data of ground water ground water sample shows that water is alkaline in nature and suitable for both domestic and irrigation use.
- All the parameters analysed are well within the permissible limits of safe drinking water as per Bureau of Indian standards (BIS).

ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

BACKGROUND

Road construction related impacts occur at three stages of the project:
i) Planning and Design
ii) Construction
iii) Operation
Planning and Design covers the alignment finalisation for Solan- Shimla stretch of NH-22, detailed highway design, identification of construction material sources, statutory clearances, etc. that ultimately decides the impact during later phases. Most of the impacts are during pre construction, construction and operation phases. While some of the construction phase impacts are temporary, some Operation phase impacts are continuous in nature.
Other important criterion for identification of impact is the identification of the impact zone. For present project, the direct project influence area has been considered the Right of Way (RoW) of proposed project and 500 m on either side from the edge of the road. The Proposed Right of Way (RoW) of project road is 45 m in the entire length. The indirect influence area extends from boundary of the direct area of influence and up to 15 km from the boundary of RoW of proposed road.

Environmental parameters are broadly classified into three groups.
i) Physical Environment
ii) Biological Environment
iii) Human Environment

Physical environment includes water resources, water quality, air quality and land environment.

Biological environment includes, flora, terrestrial fauna, avifauna, aquatic flora, fauna and plantations.

Human environment includes the social environment rehabilitation, employment, agriculture, housing, culture etc.

PHYSICAL ENVIRONMENT

1)Topography.
Impacts

Construction Stage
During the construction of the proposed project, the topography will change due to excavation of borrow areas, cutting of hill and fills for project related structures such as bridges, Tunnels, RoB, culverts, grade separators, etc.. Establishment of construction camps for material handling will also alter the existing topography temporarily. There will be visible change in topography due to cutting of hills. These changes will be more visible in Shimla bypass alignment as this a totally new construction.

Operation Stage
The change in topography will also be due to the probable induced developments of the project. These induced developments will be in the form of tourism and commercial establishments and residential complexes close to RoW. The change in topography will be visible due to land slide and damage to side slope and breast wall during monsoon months.

Mitigation Measures

Construction Stage
The borrow areas will be opened, operated and closed as per Specifications for Road and Bridge Works of Ministry of Road Transport and Highways (MoRTH). The borrow areas are to be filled with the rejected waste and then finally a layer of Top Soil is to be spread over it before carrying out plantation, turfing, etc. The cutting of hill slope will be done as per MoRTH specifications/Hill road manual. The surplus leftover will be disposed off at identified dump sites.

Operation Stage
During operation stage, maintenance of embankment will be carried out, so that the embankment is not affected due to soil erosion. The side slopes/ breast wall if damaged due to land slide will be repaired promptly. Benefits in the form of land levelling and tree plantations in the vicinity of the project road shall enhance the local aesthetics. The side slopes will also established through plantation of shrubs and vegetation.

2)Geology.
Impacts

Construction
The impact on geology may be from extraction of minerals; however, the quantity of material required is not much to impact the geology of the project region. About 78000 cum of aggregates and 21,00,000 cum of borrow soil will be required for construction of

Solan- Shimla section of NH-22. The quantity of material required is not much to impact the geology of the project region. It may be worth to mention that alignment is not passing through any area being used for extraction of minerals. The surplus generated will be disposed off at land identified for dumping. The proposed twin tunnels at two locations is Shogi –Shimla – Dhalli bypass will further avoid hill cutting and hence minimum impact on geology of the area.

Operation Stage
The project area is not passing through mining area and in operation phase of the project no impact is anticipated on geology of the area.

Mitigation Measures

Construction Stage
No new quarries are proposed to be opened for this project. The material will be obtained from the quarries which have valid permits and which are presently in operation. These have been identified at Panchkula.

Operation Stage
Since no impacts have been identified, therefore, no mitigation measures are warranted.

3)Seismicity.

Impacts

During Construction
The project road is a part of NH-22 and is located in hills. The project road is located in Zone IV. Road construction in the project region will not have any impact on its overall earthquake potential since no blasting is envisaged at the construction site. The Zone IV is the most hazardous zone and earthquake of severe intensity may be felt. Hence all project related structures are subjected to damage during earthquake if a proper earthquake coefficient is not considered in the design.

During Operation
No Impact on seismicity is anticipated during operation phase unless there is an occurrence of earthquake and damage to the project road.

Mitigation Measures

Construction Stage
All the project related structures will be made earthquake resistant, for this necessary design factor has been taken into the project design.

Operation Stage
In the event of occurrence of earthquake and damage to project road structures, necessary mitigation measures will be taken to repair damage to project road.

4)Physiography.

Impacts

During Construction

The impact of road construction on physiography is a function of the terrain of the area. It is most drastically altered in case of a hilly terrain or where extensive cut-and-fill operations are involved. The impact on physiography will be felt at the stretches where there are realignments, new bypasses and at locations of tunnels. The visual impacts will be felt during construction period. The change in physiography will be limited within the RoW of the project. The impacts on physiography will be felt at Kandaghat bypass, Shogi-Shimla - Dhalli bypasses and realignments proposed at certain locations to improve the geometrics of the road.

During Operation

No impact on physiography is anticipated during operation phase.

Mitigation Measures

Construction Stage

Since change in physiography will be pleasing to the eyes due to landscaping and compensatory afforestation, no mitigation measures are warranted except provision for adequate cross drainage structures that have been provided.

Operation Stage

During operation stage landscaping and plantation of side slopes will be maintained. The cross drainage structures will also be maintained.

5)Soil Erosion.

Impacts

The soils in the study area are limited due to hilly terrain and these are moderately fertile having clayey loam soil mixed with fine sand and humus. Therefore the potential for erosion is low. However, soil erosion cannot be ruled out during the torrential rains.

Pre Construction

The soil erosion may take place due to the following:

- Site preparation may involve demolition of building, clearing of brushwood, tree removal and temporary rerouting of utilities. This brings risks of erosion to the exposed ground or stored topsoil.
- Setting up of workers camp near habitations close to RoW may lead to loss of productive soils and impact the soil productivity especially at micro level.

During Construction

The soil erosion may take place at the slopes of the construction sites of cross drainage structures due to rains, at borrow areas and at construction sites which has been exposed

during monsoon. The soil erosion in the present case is more likely during the hill cutting.

During Operation
The soil erosion in the present case will be due to storm water runoff at side slopes, due to damages to breast wall and on account of landslides.

Mitigation Measures

Design Stage
The project road is located in a hilly terrain. The slope of the project road at has been fixed at 1:2 to 1:3 which is fairly stable and reduces the possibilities of slope failure. To check soil erosion on slopes and uphill, retaining wall and breast wall turfing with grasses and shrubs will be carried out. Since slopes are steep, therefore retaining wall on valley side and beast wall on hill side are proposed.

Construction Stage
Prior to the start of the relevant construction, the contractor shall submit to the Independent Engineer for approval of his schedules for carrying out temporary and permanent erosion / sedimentation control works as are applicable for the items of clearing and grubbing , drainage excavation, embankment / subgrade construction, bridges and other structures across water courses, pavement courses and shoulders. Contractor shall also submit for approval his proposed method of erosion / sedimentation control on service road / inspection road and borrow areas and his plans for disposal of waste materials. Work shall start only when the Engineer has approved the erosion / sedimentation control schedules and methods of operations for the applicable construction.
The surface area of erodible earth material exposed by clearing and grubbing and, excavation, borrow and fill material operations shall be limited to the extent practicable. The contractor will provide immediate permanent or temporary erosion control measures to prevent soil erosion and sedimentation that will adversely affect construction operations, damage adjacent properties or cause contamination of nearby watercourses and ponds etc.

Operation Stage
The turfing shrubs plantation and maintenance of breast wall and retaining wall shall be monitored regularly and in case of any sign of damage of retaining wall and breast wall immediate action will be taken to restore. Any loss of grass and shrubs on side slopes will also be made up before onset of monsoon season.

6)Compaction of Soil.

Impacts

Pre-Construction Stage
Compaction of soil will occur in the pre-construction phase due to movement of the construction equipment and machinery and during the setting up of construction camps. The road being on hill, this impact is of no significance as surface in the entire length is rocky.

Construction Stage
Compaction will be beyond the main carriageway and service roads and within the vegetated area of the RoW by the movement of vehicles and heavy machinery. Movement of vehicles during road construction is the major cause of soil compaction and this may also occur along haul road and near borrow areas during cartage of borrow materials. This impact is direct and will be the most in the RoW. It is necessary to ensure that there is no adverse impact of soil compaction in areas other than the RoW, where vegetation can grow and rain infiltration will take place. It may be mentioned that for cartage of borrow areas there will be usage of designated road due to presence of undulating surface and hills and hence chances of compaction in open land around RoW or borrow raes is unlikely.

Operation Stage
During the operation period compaction will be restricted to the carriageway of the project road and service roads. Compaction cannot be said to be an impact of the operation stage as the pavement itself is a function of compacted base and sub base.

Mitigation Measures

Pre-Construction Stage
During pre- construction stage, establishment of construction camp and installation of plants and machinery at campsite, machinery and equipment will be unloaded and kept at campsite only. All construction vehicles will move and be parked at the designated locations only. The movement of construction machinery and plants preferably will be limited to RoW. All Haul roads shall be constructed and maintained in good condition.

Construction Stage
During Construction phase all construction vehicles will ply within the RoW and identified routes. In no case these shall ply through open land or agriculture fields.

Operation Stage
No mitigation measures are warranted.

7)Contamination of Soil.
Impacts

Pre-Construction Stage
Contamination of soil in the pre-construction stage may be considered as a short-term residual negative impact. Soil contamination may take place due to solid waste contamination from the labour camp set up during pre-construction stage. This impact is significant at locations of construction camps, hot mix plants, etc. as these will come up in this stage.

Construction Stage
Contamination of soil during construction stage is primarily due to construction and allied activities. The sites where construction vehicles are parked and serviced are likely to be contaminated because of leakage or spillage of fuel and lubricants. Pollution of soil can also occur in hot-mix plants from leakage or spillage of asphalt or bitumen. Refuse and solid waste from labour camps can also contaminate the soil. Contamination of soil during construction might be a major long-term residual negative impact. Unwarranted disposal of construction spoil and debris will add to soil contamination. This contamination is likely to be carried over to water bodies in case of dumping being done near water body locations. In the current case the surplus generated will also contaminate or occupy the land if disposed off improperly on productive agriculture land.

Operation Stage
During the operation stage, soil pollution due to accidental vehicle spills or leaks is a low probability but potentially disastrous to the receiving environment, should they occur. These impacts can be long term and irreversible depending upon the extent of spill. However, monitoring of soil quality will be done during construction & operation phases. The soil contamination may take place if there is head on collision with the tankers carrying hazardous substance with another vehicle or there is overturning of tankers on curves.

Mitigation Measures

(i) Contamination of Soil from Fuel and Lubricants

Construction Stage
At various construction sites, the vehicles and equipment will be maintained and refuelled in such a fashion that oil/diesel spillage does not contaminate the soil. It will be ensured that the fuel storage and refuelling sites are kept away from drainage channels and important water bodies. At the wash down and refuelling areas, “Oil Water Separators” shall be provided. All spills and discarded petroleum products shall be disposed off in accordance to the Himachal Pradesh Pollution Control board Guidelines. Fuel storage and refuelling areas will be located at least 500 m from all water bodies crossing the alignment.
In all fuel storage and refuelling areas located on agricultural lands or productive lands, the topsoil preservation shall be carried out.

Operation Stage
Probability of contamination of soil being only from the road runoff, which is directed into nearest water bodies through well-designed drains, no impact on the soil during operation stage except in case of accidents, is anticipated. Accidental spillage will be handled as per established emergency procedure. This emergency procedure will be developed by the concessionaire once project road is opened for vehicular traffic.

(ii) Contamination of Soil from Construction Wastes and Quarry Materials

Construction Stage
It will be required that earth works are carried out strictly in accordance to the design drawings. Unsuitable earth, if required, will be dumped in approved areas. The spoils will be used to reclaim borrow pits and quarries, low-lying areas in barren lands and in settlements along the project corridors. All spoils will be disposed off and the site will be fully cleaned before handing over. The construction wastes will be dumped in selected dump sites. These dump sites will be developed in consultation with State Pollution Control Board. Non-bituminous wastes from construction activities will be dumped in borrow pits and covered with a layer of the conserved topsoil. Bituminous wastes will be disposed off in approved dumping site.

Operation Stage
In operation stage no mitigation measures are warranted as no impacts have been identified. The dump sites identified will be properly reclaimed and closed. These shall be secured with fencing and side slopes of these dumping sites will also be stabilised through plantation of shrubs.

8) Loss of Productive Soil.

Impacts

Design stage
Loss of productive soil takes place if alignment is passing through agriculture area. The project road section is passing through hilly terrain for almost its entire length. Hence, loss of productive soil is not anticipated much as the strata is rocky.

Construction stage
Loss of productive soil of RoW will take place. Total requirements for earth works have been estimated as **2100000 m3.**

Operation Stage
No Impact is anticipated in operation phase.

Mitigation Measures

Design Stage
To the extent possible alignment of project road has been selected to minimise acquisition of productive agricultural land. In the selection of borrow areas for the project, productive agricultural areas have been avoided for borrowing of materials unless and until

unavoidable.Traffic detours, temporary diversions required during construction will be finalized so as to avoid or minimise temporary acquisition of productive agricultural lands.

Pre Construction Stage
The camps will be sited on unproductive land only unless unavoidable. Topsoil in case of productive land will be stripped to a depth of 150mm and stored as per IRC guidelines. After completion of work these areas shall be restored.

Construction Stage
At location of alignment in agriculture areas, at construction camps, borrow areas in productive lands and all areas to be permanently covered, the top soil will be stripped to a specified depth of 150 mm and stored in stockpiles of height not exceeding 2m. The stockpiling will be done in slopes of 2:1, to reduce surface runoff and enhance percolation through the mass of stored soil. The locations of top soil storage will be identified by the Independent Engineer.
The stored topsoil will be spread back to maintain the physico-chemical and biological activity of the soil. The stored topsoil will be utilized for:

- Covering all disturbed areas including for the redevelopment of borrow areas;
- Top dressing of the embankments and fill slopes;
- Filling up of tree pits, proposed as part of compensatory afforestation; and
- Filling up of the median for shrub plantation
- To prevent any compaction of soil in the adjoining productive lands, the movement of construction vehicles, machinery and equipment will be restricted to RoW / Construction Camps.

9) Borrow Pits for the Project.
Impacts

The total quantity of earthworks for Solan Shimla section project road widening is about 2100000 m3. As many as 6 borrow areas have been identified within a maximum lead distance of 8 km from the proposed project alignment. It has been estimated that the volume of earth available is sufficient for the earthworks.

Construction Stage
Cartage of the borrow materials to the construction sites is of significance, as almost all such areas are accessible through dirt tracks only and therefore, spillage and compaction of soil along these tracks will be a significant impact. Proper protections measures need to be worked out for minimising such impacts during the haulage of borrow materials. Rehabilitation of borrow areas from which earth has been excavated, is a potential problem which needs to be addressed. In addition to visual blight, safety issues shall also be considered. Opening of borrow areas may result in loss of productive soil. Moreover, the borrow area pits, if not treated properly after the borrowing is complete, can form stagnant pools and pose health hazards. To prevent such occurrences, redevelopment of borrow areas need to be worked out. Additionally, they can also act as breeding ground for vectors like mosquitoes especially just after monsoon.

Mitigation Measures

Design Stage

For borrowing of earth for the project, 6 borrow area locations have been identified and recommended.

Following precautions will be taken to restrict unauthorised borrowing by the contractors

- No borrow area shall be opened without permission of the Independent. Engineer. The borrowing shall not be carried out in cultivable lands, unless and until, it shall be agreed upon by the Independent Engineer that there is no suitable uncultivable land in the vicinity for borrowing, or there are private landowners willing to allow borrowing on their fields. The contractor has to ensure that, there is no loss of productive soil and the requisite environmental considerations are met with.
- Location of source of supply of material for embankment or sub-grade and the procedure for excavation or transport of material shall be in compliance with the environmental requirements of the MoRTH .
- Redevelopment of the identified borrows areas worked out, as part of the project preparation will be implemented to mitigate the impacts.

Construction Stage

To avoid any embankment slippages, the borrow areas will not be dug continuously. In case borrow areas other than specified are selected, the size and shape of borrow pits will be decided by the Engineer. Borrowing of earth shall be carried out at locations. The mitigation measures to be adopted for borrow areas at different land uses are given below:

Non-Cultivable lands: Borrowing of earth will be carried out upto a depth of 1.0 m from the existing ground level. Borrowing of earth shall not be done continuously. Ridges of not less than 8m width shall be left at intervals not exceeding 300 m. Small drains shall be cut through the ridges, if necessary, to facilitate drainage. Borrow pits shall have slopes not steeper than 1 vertical to 4 horizontal.

Public or Private agricultural lands: Borrowing of earth shall not be carried out on productive lands. However, in the event of borrowing from productive lands, topsoil shall be preserved in stockpiles. A 150mm layer of the top soil shall be stripped off from the area designated for borrowing and it shall be stored in stock piles in a designated area of height not exceeding 2m and side slopes not steeper than 1:2. At such locations, the depth of borrow pits shall not exceed 45 cm and it may be dug out to a depth of not more than 30 cm after stripping the 15 cm top soil aside.

Borrow pits on the riverside: The borrow pit shall be located not less than 15m from the toe of the bank, distance depending on the magnitude and duration of flood to be withstood. Precautionary measures like the covering of vehicles will be taken to avoid spillage during transport of borrow materials. To ensure that the spills likely to result from the transport of borrow and quarry materials do not impact the settlements, it will be ensured that the excavation and carrying of earth will be done during day time only. The unpaved surfaces used for the haulage of borrow materials will be maintained properly.

The contractor shall evolve site-specific redevelopment plans for each borrows area location. These site specific borrow areas redevelopment plans will be approved by the Engineer.

10) Quarries.

Impacts

The excavation of quarries and borrow pits used for obtaining rocks, soil and aggregate materials for road construction can cause direct and indirect long-term adverse impacts on the environment. Although the cut operations shall generate ample soil material it is likely that material from quarry and borrow areas could be needed depending on the appropriateness of the material quality. The impacts of quarrying operations could be significant at various stages of road construction. Quarrying and crushing could have a critical impact especially on the air quality of the area especially the area in the downwind direction of the quarry. The stage wise impacts are as described below:

Pre Construction Stage

Existing quarries that are already in operation have been identified and have been recommended for this project. No new quarries have been proposed. The bulk of the materials needed for the construction of the embankments will be procured from the existing quarries. These quarries have been identified at Panchkula in Haryana. As these quarries are already in operation with the requisite environmental clearances and redevelopment plans, no major impacts, which arise in making new quarries operational, are likely. Necessary environmental mitigative measures recommended by the Haryana Pollution Control Board are being followed at these quarries.

Construction Stage

A major source of dust during the construction stage is from stone crushing operations from the crusher and the vibrating screen. The dust, in addition to being an eyesore, reduces visibility thereby increasing safety concerns. Dust is generated due to procurement and transport of raw materials from quarries and borrows sites to the road construction area. These impacts will persist till the activity ceases. The regions especially downwind to the quarries/borrow areas are more vulnerable to air pollution. As no new quarry needs to be opened for this project, therefore, no new impacts are likely to arise due to quarrying operations. The material from these quarries and crushers will be transported from Panchkula through the existing highway.

Mitigation Measures

Design Stage

As part of the project preparation process, an evaluation of all existing quarries along the corridor has been carried out and the status in terms of the suitability of the quarry material and their legal status have been assessed. The crushers operating at quarries at Panchkula have already been identified by the design team.

Construction Stage

It will be ensured that quarries from where material is taken have all valid permits & licenses and the haul road network is properly maintained.

Operation Stage

No mitigation measures from project end are warranted.

11) Land Use.
Impacts

Pre - Construction and Construction Stage
There will be change of landuse for land falling within the RoW of the project road. The predominant landuse of RoW is Hilly terrain and waste land. There will be acquisition of land to the extent of 210 ha for the project. This comprises of 164 Ha private lands and 46 Ha Government land. .

Operation Stage
In operation stage no impact on land use changes in RoW of project road is anticipated. However, there may be induced land use changes close to RoW near urban areas and bypass/ realignments.

Mitigation Measures
The compensation for land acquisition will be made as per the provisions in the resettlement Plan.

12) Meteorological Parameters.
Impacts

Construction Phase
The entire alignment of Solan-Shimla section of project road is located in a region that experiences typical tropical climate with marked monsoon effects. Though no change in the macro-climatic setting (precipitation, temperature and wind) is envisaged due to the project, the microclimate is likely to be temporarily modified by vegetation removal and the creation of paved surface for road and its structures construction. This microclimatic change may result in reduced precipitation and slight increase in temperature. The increased in temperature may be felt localised.
Although the impact is significant and long-term and reversible in nature and shall be compensated for by compensatory plantation of trees, it must be noted that the impact is unavoidable. However, it may be pointed out that the project has taken due care to minimise tree felling in the RoW by realigning the alignment to save dense tree plantation stretches and habitation areas.

Operation Phase
In the operation phase no impact on meteorological parameters is anticipated.

Mitigation Measures

Design and Construction Stage
Avoidance measures, as the minimising of the number of trees to be cut, have been worked out as part of the design finalisation. The project will involve significant cutting of trees in the RoW. Though no change in the macro-climatic setting (precipitation, temperature and wind) is envisaged due to the widening of NH-22 section from Solan to

Shimla, the microclimate is likely to be temporarily modified by vegetation removal, and due to construction of paved pavement surface.
In order to compensate negative impacts on flora due to cutting of trees the project plans compensatory plantation in the ratio of 1:3 i.e. for every tree to be cut three trees will be planted. There is planning to plant 20352 trees as compensatory plantation.
Compensatory afforestation in the available space of RoW, planting along the median and turfing of side slopes proposed shall help in restoring the green cover along the project corridor. The project proponent as part of DPR will prepare a detailed tree plantation and turfing plan as part of project implementation.

13) Ambient Air Quality.

The ambient air quality of project influence area will be affected during pre construction, construction and operation phases. Pre Construction and construction phase impacts will be intermittent in nature and will change from location to location as work progresses and continues. These types of emission sources cannot be categorised point, area or line sources. The quantification of emission is difficult for pre construction and construction phases. During operation phases vehicular emissions emitting from traffic will be from line source. The emissions from these vehicles have been quantified and modeled.

Impacts

Air quality along the project corridor will be adversely impacted both during the construction and operation stages. Construction stage impacts will be of short term and have adverse impacts on the construction workers as well as the settlements adjacent to the road, especially those in the downwind direction. Construction stage impacts will be confined generally to a band of width ranging from 50 to 100m from the edge of the Proposed Right of Way. However, they will continue for the entire life of the project. The following sections present the impacts of the project activities on this component.

Generation of Dust

Pre Construction & Construction Stages

Generation of dust is the most likely impact during these stages due to:

- Site clearance and use of heavy vehicles, machinery, etc.;
- Procurement and transport of raw materials and quarries to construction sites; the impacts will mostly be concentrated in the RoW. It is likely that impacts due to dust generation are felt downwind of the site rather than on the site itself.
- As the entire project corridor has a soil type with significant silt content and the construction activities to be carried out during the dry season when the moisture content would be less, dust generation, particularly due to earthworks will be significant. Dust is also likely to be generated due to the various construction activities including:
- Stone crushing operations in the crushers;
- Handling and storage of aggregates in the asphalt plants;
- Concrete batching plants; and
- Asphalt mix plants due to mixing of aggregates with bitumen.

Generation of dust is a critical issue and is likely to have adverse impact on health of workers in quarries, borrow areas and stone crushing units. This is a direct adverse impact, which will last almost throughout the construction period.

Operation Stage

No dust generation is envisaged during the operation stage as the project road shall be paved and there will be turfing on side slope and plantation on shrubs. More over project site remains moist during winter month due to snow fall or frost.

Generation of Exhaust Emissions

Pre Construction & Construction Stages

Generation of exhaust gases is likely during the pre-construction stage due to movement of heavy machinery for clearance of the RoW for construction. This impact is envisaged to be insignificant during the pre-construction stage.

High levels of SO2, HC and NOx are likely from hot mix plant operations. Toxic gases are released through the heating process during bitumen production. Although the impact is much localised, it can spread downwind depending on the wind speeds. The Environmental Management Plan needs to ensure that adequate measures are taken especially for health and safety of workers such as providing them with pollution masks during working hours. Also, the contractor should ensure that hot mix plants, stockyards, crushers etc. are away from residential areas and residential quarters of all workers. If adequate measures are taken, impacts from generated gases can be considered negligible.

Operation Stage

The major impact on air quality will be due to plying of vehicles. Increase in air pollution is also identified by the public as one of the most undesirable impacts of any new road development project. The impacts on air quality will, at any given time depend upon traffic volume/rate of vehicular emission within a given stretch and prevailing meteorological conditions. Excess discharge of exhaust gases can occur due to (i) inadequate vehicle maintenance; (ii) use of adulterated fuel in vehicles and/or (iii) poor road conditions. To predict air quality in the vicinity of the project road alignment during operation phase air pollution modelling has been carried out to quantify the impacts incorporating all these variables.

14)Water Resources.

Impacts

The project road crosses Kathulu Ka Nalla at km 131.800, Samri Nalla at km 137.500, Kair Ka Nalla at km 147.570 and Kallali Ka Nalla at km 156.165. There are no road side ponds or lake along the project road alignment. All the drains except Samari Nalla are seasonal. These surface water bodies can be subject to adverse impacts due to the various construction activities as well as during the operation stage of the project. Contamination to water bodies may results due to spilling of construction materials, oil, grease, fuel and paint in the equipment yards and asphalt plants.

Water table along the project road is very low due to rocky strata. The construction and operation of the proposed project roads is not expected to have any major impacts on the surface water. Ground water potential is not much due to hilly terrain. The poor ground water potential will deter use of ground water for construction. Hence impact on account of project implementation on ground water is not expected.

Mitigation Measures

Design Stage
Since all the water bodies except Samri Nallah are seasonal, therefore, construction of bridges across all streams will be taken up during lean season flow. The water usage for construction will be taped either from some local spring or through these streams after permission from authorities.

Construction stage
The hand pumps coming in the proposed right of way will be replaced. The community tube wells have not been seen in the RoW. In case of these being private property the compensation will be paid as per the provisions in the R&R Plan. Required number of cross drainage structures shall be provided for maintaining the natural drainage. Labour camps shall be sited at least 1000 m away from the water body.

Operation Stage
In operation stage to avoid any impact on water resources in the NH-22 portion from Solan to Shimla storm runoff has been properly channelised through designed drainage system.

15) Loss of Water Bodies / Groundwater sources.

Impacts

Water table along the project road is quite low as project road is in hilly terrain. The construction and operation of the proposed project roads is not expected to have any major impacts on the surface water and the ground water quality in the area.
In the entire length no Tube well and Hand Pumps are present hence impact on these is nil.

Mitigation Measures

Mitigation Measures for Ground Water
Design Stage.
Avoidance of water supply sources water taps and hand pumps been worked out in the design of the alignment. Since no water supply sources are being impacted, therefore, no mitigation measures are warranted.

Pre- Construction Stage
The relocation of private and community water supply sources if any found during the pre construction stage shall be completed prior to the commencement of the construction by the contractor, in accordance to the utility and community assets relocation plan prepared for the project. To prevent any stress on the local water sources due to the relocation, the process of dismantling shall commence only after the provision of the water supply source at the relocation site is agreed upon by the community. The contractor will identify water sources for construction, which in all probability will be local springs/streams. Necessary permission for water usage will be obtained from the competent authority.

Operation Stage
During operation stage no impact on ground water resources is anticipated hence no mitigation measures are warranted.

16) Increased Sediment and Degradation of Surface_Water Quality.

Impacts

Pre-construction and Construction Stage
The degradation of water quality can occur during construction stage from increased sediment load into watercourses near the construction site. This may be aggravated by removal of trees and consequent increase in soil erosion. However, as the project length is relatively small to have any regional impact and will be crossing only smaller streams(no major river), the impacts due to the increased sediment load is not expected to be significant.
Degradation of water quality is also possible due to accidental discharges into watercourses from drainage of workers‟ camps and from spillage in vehicle parking and/or fuel and lubricant storage areas.

Operation Phase
During the operation phase, there is little chance of degradation of water quality during normal operations. The implications of accidental discharge are potentially disastrous. However, it must be emphasised that the probability of such an accident is quite low. The design of the NH-22 portion incorporates all safety features required as per IRC requirements.

Mitigation Measures

Construction Stage
To avoid contamination of the various surface water bodies and drainage channels near the construction site, construction work close to the streams or other water bodies will be avoided, especially during monsoon period. All necessary precautions will be taken to construct temporary or permanent devices to prevent water pollution due to increased siltation and turbidity. All wastes arising from the project will be disposed off, as per Himachal Pradesh Pollution Control Board norms, so as not to block the flow of water in the channels. The wastes will be collected, stored and taken to the approved disposal sites.
The vehicles and equipment will be properly maintained and refuelled, so as to avoid contamination of the water bodies and drainage channels from fuel and lubricants. The slopes of embankment leading to water bodies will be modified and re-channelised so that contaminants do not enter the water body. Oil and grease traps will be provided at fuelling locations, to prevent contamination of water. The sewage system for construction camps will be properly designed and built so that no water pollution takes place to any water body or watercourse.

Operation Stage
Proper maintenance of the side slopes, retaining wall, breast wall, median drains, side drains and protection measures near water sources would be ensured by the project proponents.

17) Flood Hazards.

Impacts During Preconstruction and Construction
The flood hazards in the project are not there as project road is on elevation and on hill having quick drainage system.
During construction flood hazards may be possible at bridge construction location of streams if flow is obstructed. There no chances of inundation.

Impacts During operation
During operation, no impact of flooding is anticipated. For runoffs from the carriage there may be temporary local accumulation of water in case adequate side drainage structures are not provided.

Mitigation Measures

Preconstruction Stage and Construction Stage
During construction local drainage at construction site will be maintained to avoid flooding.. In order to ensure free flow in the side drains, proper maintenance will be carried out at regular intervals especially just before the monsoon season.

Operation Stage
In operation phase the turfing and protection measures will stabilize the side slopes and approaches of major bridges and elevated portion in first 2-3 years. In the initial two years, proper maintenance will be carried out for any damage.

18) Drainage

Impacts

Impacts of road construction, which lead to alteration of drainage, are generally due to construction of cross drainage at locations of crossing. This requires river and or gully training for the period during which the bridge and cross drainage structures are to be constructed. Alteration of drainage can lead to soil erosion of adjacent areas, disturb local vegetation. If the period of alteration is long, there are chances of local ecology being impaired. However, as mostly cross drainage works are done in summer when the water levels are low in the rivers and streams, the impacts due to alteration of drainage can be minimized effectively with adequate mitigation measures and pre planned construction schedules. The proposed project road will not alter drainage pattern of the area as adequate cross drainage structures have been planned. At locations of realignments and bypasses the impact on drainage pattern of the area will be due to construction of the road pavement. These embankments will be an impediment to the natural drainage of the area if adequate cross drainage structures are not constructed. More over the project road being on hill will be subjected to uphill storm water drainage system. This may cause

damage to project road, breast wall, retaining wall if proper drainage system is not built as part of project road.

Pre Construction Stage

No drainage modification of surface flow of local streams namely Kalali Ka Nallah, Samri Nallah, and Kair Ka Nallah is envisaged during pre-construction period hence no impacts area anticipated. In the project design side drain towards breast wall side.The project plans to have adequate size 89 culverts in Shogi – Shimla - Dhalli bypass. In the existing project road widening portion there are 167 culverts. The project plans to retain 140 culverts and reconstruct another 27 culverts. There will be construction of new culverts in the new two lane portion and in case of widening on either side existing culverts will be widened.

Construction Stage

Though construction along the watercourses is to be carried out in the lean flow periods, as the streams mentioned will have some flow and the construction activities will necessitate diversion of the waterways. During the construction there will be some diversion of waterway. This diversion of flow may significantly harm the aquatic habitat, present if any. The waterway of the streams will become constricted due to diversion and this will caused increased velocity downstream of the bridge. This will mean increased sediment load with the flow, thereby allowing less sunlight to penetrate into the water and can reduce growth of flora. The impact shall be direct but short term in nature and shall last as long as construction continues.

Mitigation Measures

Design Stage

To ensure efficient cross-drainage and to prevent water logging along the sides, adequate size and number of cross-drainage structures and side drains have been provided. All cross-drainage structures have been designed to handle a 50-year peak flood level.

Construction Stage

The contractor will remove obstructions that may cause any temporary flooding of local drainage channels during construction. No spoil or construction material will be stored outside the proposed RoW or at places obstructing the natural drainage system.
Based upon the findings of field investigations supplemented with proposed cross drainage structures inventory, it has been decided that following mitigation measures planned for effective drainage.

- An effective surface and subsurface drainage system of pavement structures has been designed as stipulated in IRC as per site conditions.
- Storm water shall be directed away from the respective bridge deck by providing kerb & gutter.
- Water course -these shall adequate capacity for the design run-off and be located and shaped to avoid creating traffic hazard and erosion of soil.
- Drainage channels and pipe shall be installed at crossings with service pipes and utilities ensuring that conflicts do not occur.

Operation Stage

To maintain an efficient storm water flow, all drains will be regularly cleaned as part of the road maintenance. This cleaning will be taken up during monsoon months.

19) Hydrology

- **Surface Water Hydrology**

Impacts

Pre - Construction and Construction Stage

The construction of bridges and elevated structure will not change surface water hydrology as all bridges will be having a obstruction free cantilever beam supported bridges or suspension bridges.. Hydrological impacts may be felt at bridge construction sites if proper water way width is not maintained.

Operation Stage

During operation stage impact on surface water hydrology will be felt if side drains are not effective and tunnels do not provide adequate cross drainage. In that situation, flooding may be felt during monsoon season.

Mitigation Measures

Preconstruction and Construction stage

Adequate water way width will be maintained during construction to ensure no impacts on hydrology.

Operation stage

During operation stage no impacts are anticipated due to project implementation as design takes care of mitigation measures. These mitigation measures will be implemented during construction stage. All side drains will be cleaned and properly maintained before onset of monsoon each year

- **Ground Water Hydrology**

Impacts

The impacts on ground water hydrology due to road construction will be in RoW on account of compaction and rising of embankment.

Mitigation

The project is not located in a flood prone area. As such the length of the alignment is relatively small to have any significant impact on the ground water hydrology.

BIOLOGICAL ENVIRONMENT

1) Terrestrial Flora.

Impacts

Roadside Plantations and Protected Reserved Forest Areas

The alignment of Solan- Shimla bypass is passing through reserved and protected forest at few locations. The total forest area to be acquired is approximately 82 Ha comprising of 72 ha unprotected forest and 10 ha Protected forest. The principal impact on flora involves the removal of trees from the RoW. Cutting of around 7000 () trees is expected due to the project. The scheduled tree species are Deodar, Ban, Kail, Khark, Tuni, Quhl, Kachnar,etc. There are no endangered species or rare species of flora and fauna in the project area.

Pre Construction Stage
The project has direct and long-term impact on the trees within the RoW. The cutting of trees shall have manifold impact. Most visible impact is the loss of shade. Also, there is a possibility of the local people and fauna being deprived of tree products, such as wood, fruits, leaves etc.

The removal of trees will not only lead to erosion, and depletion of the ground water table, but also to the loss of the micro-ecosystems developed in the project area. Since most of trees to be removed are in hilly open terrain.

Construction Stage
During construction stage no cutting of trees will be involved within the RoW, but there may be accidental cutting of trees by the construction workers for cooking of food near the construction camps. The compensatory plantation and plantation in median will also take place at the end of construction period.

Operation Stage
During operation stage there will be positive impact on flora as compensatory plantation in RoW will grow and shrubs plantation on side slopes will also mature.

Mitigation Measures Terrestrial Flora

Design Stage
It In order to compensate negative impacts on flora due to cutting of trees the project plans compensatory plantation in the ratio of 1:3 i.e. for every tree to be cut three trees will be planted. There is planning to plant 20202 trees as compensatory plantation. In addition to this compensatory plantation there will be plantation of shrubs in the median. Necessry permission will be obtained from the forest department to cut the scheduled trees.

Construction Stage
No trees out of RoW will be felled. The trees to be cut will be marked inside the RoW. Construction vehicles, machinery and equipment will move or be stationed in the

designated area only to prevent compaction of vegetation. While operating on temporarily acquired land for traffic detours, storage, material handling or any other construction related or incidental activities, it will be ensured that the trampling of soil and damage to naturally occurring (RoW or Construction Camp) herbs and grasses will be avoided.

2) Aquatic Flora.

Construction Stage

There will minor adverse impact on aquatic flora near major bridge construction sites (21 minor bridges and 11 major bridges Nos.) especially at time of construction activities in river bed.

Operation Phase

The aquatic flora damaged during construction will grow after completion of activities. But some minor impact is anticipated as river bed will have bridge abutments and these will prevent growth of flora near banks.

Mitigation Measures Aquatic Flora

Construction Stage

Bridge construction is planned during lean flow periods. All waste materials will be disposed off at identified and safe locations away from the river.

Operation Phase

Mitigation measures are not needed as linear velocity at bridge location sites will not change increase more than 10 % as in most cases there will be no structure within the mid stream.

3) Terrestrial Fauna

Impacts

No potential impact on fauna is envisaged due to construction of project road as it is not close to any of the area rich in wildlife. No Notified Wild Life Parks/ Bird Sanctuaries are located even within indirect project influence area of 10 km.

Mitigation Measures

Construction Stage

All construction activities will be carried out in such a fashion that damage and disruption to fauna will be the minimum. The construction workers will be given instructions to conserve/protect natural resources and fauna, including wild animals and aquatic lives. The alignment of bypass of Shogi- Shimla - Dhalli is planned through the area used by the locals to travel from village to village.

Operation Stage

Although no impacts on fauna in operation stage are anticipated directly due to the project, certain measures shall be taken. In the operation phase a positive impact on fauna is anticipated due to enhanced tree cover in the RoW. The enhanced tree cover will provide a good nesting ground for the fauna.

4) Human Use Values

Land Acquisition

The alignment of project road follows the existing in about 45 % project length and will have 2 major bypasses proposed Shogi, Shimla , Dhalli and Kandaghat.. In addition to these bypasses minor realignments have been proposed at seven locations for the geometric improvements. There will be marginal land acquisition along the RoW at proposed realignments and for bypasses there will be acquisition of land for the entire length.. The compensation for land acquisition will be made as per policy of Government of India (GoI) and National Highways Authority of India (NHAI). It is estimated that there will be acquisition of about 210 Ha which comprises of 164 Ha private land 46 Ha Government land.

Loss of Private Properties

There shall be loss of some private properties due to widening in the habitations. The compensation for losses will be paid as per policies of GoI and NHAI. It has been estimated that about 270 structures will be demolished.

Common Properties Resources

In the RoW there will be loss of some permanent structures and human use values such as ponds, tube wells, hand pumps, wells, and religious structures. The compensation will be paid to the owners as per provisions in the R&R Plan. The religious structures will be relocated before start of construction with rituals and in consultation with locals. The resettlement action plan of the project being separately taken up will have more elaborations on these aspects. The loss of common property resources, private and permanent structures has been summarised below.

	Number(s)
1 Hand pump	Nil
2 Tube Wells	Nil
3 Pond	Nil
4 Canal	Nil
5 Temporary Structures (including boundary walls)	52
6 Permanent Structures	270
7 Mazars and Samadhis	Nil
8 Religious Structures	07
9 Hospitals and Dispensaries	Nil

Change in land use

The development due to the Project will induce a change in the land use along the alignment. Change in land use will be sparked off as a result of land speculation. The NH22 (Solan-Shimla Section) once constructed will be the magnet for commercial and residential development. The commercial development will be mainly related tourism such as

resorts/hotels/restraints and trading hubs for fruits. This will improve economic conditions of people.

Land Speculation

Better connectivity will also mean that the value of properties adjacent to project road will rise almost overnight. The lure of business from road users is usually the main magnet.

Cropping Pattern and Crop Productivity

The proposed project is likely to bring in its wake, new townships, commercial and trading developments and changes in land use. This translates into change of land currently under agriculture to more commercial and industrial use. It is envisaged that due to this proposed change, the crop productivity in the agricultural belt immediately adjoining the RoW shall decrease. This impact is envisaged only to be valid for the agricultural land adjacent to the RoW. Although the spatial impact is likely to be insignificant, the impact will be irreversible in nature. Cropping pattern after development of road will change as farmers will switch over to cash crops as there will be availability of fast transport system to urban areas.

Exploitation of Resource base

Development of a road in areas previously not easily accessible can work like a double edged sword for the environmental resources in the area. While the road would unlock potential value in the area, stimulate growth and make the environment hospitable, at the same time, the rapid depletion of natural resources is also possible.

Development of such vital infrastructure will lead to over exploitation of the environmental resources (stone crushing, cutting of trees from the waste land, indiscriminate disposal of waste in the streams, etc.). While the medium term impacts may not be large enough to be noticed, the long-term implications of such depletion are potentially disastrous.

5) Consumption of Natural Resources.

The proposed NH-22 works for Shimla - Solan section envisage the use of significant quantities of the earth, stone and grit and sand along with bitumen. The quantities required for the project are as under:

Earthwork (Cum) :	2098230.00
GSB(granular sub base) (Cum) :	76537.00
WMM (Wet mix macadam) (cum)	152521.00
DBM (dense bitumen macadam) (cum)	54732.00
Sand (Cum)	55657.00
BC (Cum) :	25879.00

ACCIDENTS INVOLVING HAZARDOUS MATERIALS

Impacts

Pre Construction and Construction stage
The storage of the inflammable and toxic materials may result in accidents during construction phase. There will be storage of explosive at crusher site for rock blasting and cutting. Accident may result due to improper handling of explosives at crusher sites.

Operation stage
During operation, phase impact will be due to accidental spillage of hazardous and toxic materials from a tanker of transporting this material. This accidental spillage may occur due to vehicles overturning or due to vehicle collision specially at curves.

Mitigation Measures

Pre Construction and Construction Stage
During pre construction and construction stage the storage of hazardous materials will be after obtaining permissions/ license from Chief Controller of Explosive, Nagpur. Necessary precautions as stipulated in conditions of license will be enforced. The contractor will prepare an onsite emergency plan for construction site, construction camp and crusher site. This plan will be reviewed and approved by Independent Engineer.

Operation Stage
Accidents involving hazardous chemicals will generally be catastrophic to the environment, though the probability of occurrence is low. Prevention of an accident involving hazardous material is a better way of minimising the impacts. Vehicles delivering hazardous substances will be printed with appropriate warning signs. In case of spillage due to vehicle collision, the report to relevant departments will be made. This incident will be brought under control as per disaster management plan prepared for operation phase.

WASTE LOAD (SOLID WASTE) LIKELY TO BE GENERATED

Construction Phase
The waste load (waste material) will be generated during construction phase due to maintenance of vehicles and construction machinery, spillage of construction material and discarded low grade material at construction camps. Out of all these waste lubricant oil generated due to regular vehicle maintenance will be about 2500 litres per year.This oil is hazardous waste as per provisions of manufactures storage and Import of Hazardous Chemical Rules, 1989. The other wastes generated will be non hazardous in nature. The quantum of waste load generation in entire construction phase will be around 0.5% of total construction material handled. This is based on current project under implementation in the country. In case of NH 22 (Solan- Shimla Section), total usage of construction materials is estimated to be 2.44 X 10^6 cum. Hence total waste generation (non hazardous in nature) is likely to be 0.12 million m3 (approx). This material will be recyclable for land filling or low lying area filling.

Operation Phase

During operation,no significant generation of solid waste is likely to except due to vehicular accidents and domestic waste at toll plaza. This generation will not exceed 2 to 3tonnes per year. This will be dumped to nearest municipal land fill site available.

SAFETY

Impacts

The concern for safety stems from the proposals for faster vehicular movement along the Solan- Shimla section of NH-22. Though speedy travel is one of the objectives of the project, it also increases the intensity of loss of life in case of an accident.

Mitigation Measures

Design Stage

Safety of road users as well as of the vehicles plying on the NH 22 (Solan- Shimla Section) is given highest importance and adequate measures have been incorporated in the design of the alignment. The design incorporates road side amenities, properly designed curve and slope, crash barriers and / or steel Beam Guardrails, and signages as per IRC specifications. These will be installed at outer edge of shoulder on either side. The list of ROB, elevated portion , Toll Plaza, bus bays, truck lay byes, and other structures proposed in NH 22(Solan- Shimla section) are as under**.**

Structure	**Existing (Nos.)**	**Proposed (Nos.)**
Major Bridges	0	11
Minor Bridges	3	08
Culverts	185	256(140New,27Reconstruction and widening and balance 89 will be retained)
Flyover cum RoB	Nil	21
Ve hicular Underpasses	Nil	Nil
Pedestrian/Cattle Underpasses	Nil	Nil
ROB	Nil	1
Bus Bays	1	15
Bus Stops	4	Nil
Toll Plaza	Nil	1
Truck Lay byes	Nil	2

Construction Stage

Construction activities cause hindrance to traffic movement and are also hazardous for the traffic. Traffic management plans shall be prepared and temporary diversion routes will be identified to divert traffic from construction locations specially at the intersections, bridge and culvert sites etc. Signboards indicating construction sites on the road and flags shall be erected. All the signboards giving caution, barricades for diverting the traffic shall be as per MoRTH specifications.

Operation Stage
All safety measures erected at time of construction will be maintained properly. There will be special attention to the signages.

HISTORICAL, ARCHAEOLOGICAL AND CULTURAL SITES / PLACES

Construction Phase

Impacts
There is no archaeological site/protected monument location that falls under the project influence area and within 10 km radius of proposed alignment. Hence no adverse impact is anticipated. However, UNESCO World heritage rail line from Kalka to Shimla is running very close and parallel to project road from start of project road (km 106.000) to start of Shogi-Shimla-Dhalli bypass (km 131.150). The construction related activities such as hill cutting may have adverse impact on this World Heritage line.

Mitigation Measures
Since no impacts are identified, therefore, no mitigation measures are warranted. At start point where project road is crossing Kalaka – Shimla rail line elevated road cum ROB has been proposed. The length of this ROB cum elevated portion is 599.376 m. In the balance portion, widening has not been planned towards the rail line side. It has been planned on the other side.

Operation Phase

Impacts
No adverse impact on archaeological, historical and cultural sites is anticipated due to vehicular emissions and other activities of NH 22 in Solan – Shimla section.. A positive impact due to improved connectivity is anticipated.

Mitigation
No mitigation measures are needed in the light of explanation given under impacts subsection.

Tunnels

4 tunnels are proposed on Kandaghat & Shogi - Shimla - Dhalli bypass at km 117.600 to 118.060, km 135.930 to 137.160 and km 156.350 to 156.450. The construction of those tunnels will have following impact and mitigation measures.

Impacts

Pre construction
Twin tunnels have been planned to minimize heal cutting and acquisition of land. These twin tunnels precisions are to save deodar trees near Mashobara Junction and acquisition of forest land.

Construction stage
During construction, stage impacts will be due to creation of tunnel. This will produce some muck(mud). This muck if not disposed off properly will have impact on vegetation and trees in surroundings. The drainage at tunnel site if not provided properly will have impact on surroundings as waste water will get accumulated. The blast for rock cutting will produce noise. This will have impact on surroundings.

Operation stage
During operation, stage impacts will be felt in traffic movements of there is no proper lighting and drainage in the tunnels. The poor light will have visibility hazards. The noise and vibration issues during traffic movement may be felt if there is no proper design and mitigations.

Mitigation Measures

Pre construction
The planned tunnel at Masobra Junction (km 135.930 to 137.160) has saved around 60,000 Deodar trees which are move those 100 years old. The tunnels have also saved additional acquisition of 30-35 Ha of reserved forest land. Hence proposal of construction of tunnel will have positive impact on environment.

Construction
A muck generated will be utilised in the project work for filling area to the extent possible. The balance muck will be disposed off at identified dump site. This dump site will be in identified by the Independent contractor and approved by the Independent Engineer. The dump site after filling will be realigned. Adequate lighting system will be provided. Both twin tunnels are <1.5 km in length and these are normal tunnels. The drain system will be provided on either side of carriageway and it will be connected to road drainage system.

Operation stage
The concessionaire will ensure that lighting system works properly during operation. The side drains will be kept clean for quick and effective drainage.The twin tunnel systems proposed at both locations will ensure no excessive noise and vibration. The noise and vibration will be increased during the operation phase. In case access noise is felt traffic will be regulated in tunnel area.

CULTURAL PROPERTIES

Impacts

Other cultural properties include religious structures(Temple, Mosque, Church,Mazars and Samadhis). No religious structure has been found within the proposed RoW of project road. However, in the event of discovery of any religious structure during project implementation, the structure will be appropriately relocated / reconstructed in consultation with the local community.

Loss/ Disruption of Access/ Cultural Properties

Pre Construction

One of the impacts of project road widening and construction of Shogi- Shimla-Dhalli bypass and Kandaghat bypass is interrupted access to the cultural properties on eitherside of RoW. There are chances that users of the cultural property may face difficulty in accessing the property during the period of pre-construction.

Construction Stage
Loss of access is likely to be severe during the construction period, due to movement of construction machinery, construction equipment setting up of borrow areas, setting up of construction camps etc.

Operation Stage
During operation phase access to cultural properties will be minimal as proper signage and facility planned for crossing will ensure no inconvenience to the locals.

Mitigation Measures

Design Stage
Alignment has been worked out to minimise impacts on cultural/religious properties along the corridor. As part of signages crossing locations will be marked.

Construction Stage
All necessary and adequate care will be taken to minimize impacts on cultural properties close to RoW which includes cultural sites and remains, places of worship including religious structures, mentioned above.. The contractor shall ensure that no construction activities will spill over to these property‟s premises and precincts.
Access to cultural properties on either side of RoW such properties from the road shall be maintained clear and clean.

SOCIO - ECONOMIC ENVIRONMENT

Project Affected Displaced Population

As mentioned earlier there will be acquisition of land to the extent of 210 Hectares (approx). Major portion (about 95%) of this unproductive waste land.This land acquisition will have impact on socio-economic conditions of project affected persons. The project affected persons are being identified during land acquisition. Resettlement & Rehabilitation Plan has been prepared for the project affected and displaced families
under separate cover.

Impact due to Construction of Embankment
The other major social impact identified due to project is loss of access to agricultural fields and habitations on eitherside of the alignment. In many instances there will be defragmentation of agricultural fields of the same landowner. This will cause inconvenience to the locals.

Positive Impacts on Socio- Economic Environment

The positive social impact due to project will be faster connectivity to major urban centers

of the country, generation of huge employment during construction, and fast economic development in the post construction phase. There will be availability of improved infrastructure facilities.

Mitigation Measures

The compensation to project affected persons will be paid as per the provisions in the National Rehabilitation and Resettlement Policy 2006 (NPRR) of Government of India or a better compensation adopted by the National Highways Authority of India.

Positive Impact on Quality of Life (QOL)

The project will improve quality of life of public living around project road markedly due to availability of huge employment potential (growth of residential townships and industrial sector) and improved and fast connectivity.

Health

The adverse impact on health of public living near RoW of the project is not anticipated during construction phase as construction activities will be within RoW and RoW has been kept sufficiently away from habitations. The mitigations measures stipulated in previous sections will be implemented as part of EMP to avoid any adverse impact due to movements of construction machinery and vehicles on haul roads. In operation phase there will be positive impact on health of public as project will relieve traffic congestion in Solan,Shogi, Kandaghat and Shimla. Accessibility to health facilities will improve through project road especially to those villages which are located close to Kandaghat Bypass and Shogi- Shimla-Dhalli bypass alignment.

ANALYSIS OF ALTERNATIVES

Introduction

It discusses the analysis of alternatives that have been considered for the four laning of Solan - Shimla section of NH-22. It also includes a discussion on the **"With**" and "**Without"** project scenario. The methodology that has been adopted for the evaluation of the alternate alignment route for construction of the highway and the selection of bypass alignments based on engineering, economic, environmental and social considerations have been highlighted. The minimisation of environmental impacts by considering design alternatives determines the extent of mainstreaming of the environmental component. An evaluation of the various alignment options has been done for arriving at the most promising alignment for the highway and the bypasses. Here we look at the decisions made during the project when alternatives were available and describes the resoning behind each decision.

"WITH" AND "WITHOUT" PROJECT SCENARIO

Solan and Shimla are two important cities of Himachal Pradesh. Shimla is the capital city of Himachal Pradesh. The NH-22 connects these both cities. This highway has importance because it provides connectivity to Kalka, Chandigarh and Ambala. It is a popular tourist destination route. This project road carries a significant heavy traffic to and from industries, local fruits and vegetables transport and supply of essentials to these cities from the plain land. There is thus an immediate necessity to widen the existing road to enhance the economic capability of the area as well as complementing the NHDP that seeks to connect high-traffic density stretches, state capitals and tourism centres.

The project will have multiple benefits. It will reduce the travel time substantially between Solan and Shimla, the two primate cities of Himachal Pradesh. In addition the improved road will provide other benefits like

- Fast and safe connectivity resulting in savings in fuel, travel time and total transportation cost to society;
- Employment opportunity to people;
- Development of local industry, agriculture and handicrafts;
- Development of tourism and pilgrimage;
- Transporting processing and marketing of agricultural products;
- Reduction in accidents;
- Reduction in pollution;
- Opening up of opportunities for new occupations;
- Better approach to Medical & Educational services and quick transportation of perishable goods like fruits , vegetables and dairy products; and
- Improved quality of life for people and so on.

Therefore, "With" project scenario, with its minor adverse impacts is more acceptable than the "Without" project scenario which would mean an aggravation of the existing problems. The potential benefits of the proposed road improvements are substantial both in terms of the geographical spread and time. Hence, it is clear that the project will be a definite advantage to Himachal Pradesh in order to achieve all-round development of its economy and progress for its people.

ALIGNMENT FINALISATION

The proposed improvement to Solan - Shimla section of NH-22 consists of 4 laning of the carriageway from existing two lanes. The proposed improvements also include geometrics and curves, providing service road at selected built-up areas, adequate number of cross drainage structures, line drains all along hill side. There are few locations, where because of poor geometry or restricted land width, a bypass or realignment is proposed. The proposed alignment with improvement measures was examined on the basis of environmental attributes such as trees, forests, topography, flood and water logging prone areas, water bodies , soil erosion, wildlife park and sanctuaries, presence of endangered species, archaeological/historical monuments and religious structures etc.

Environmental parameters have been identified on either side of the alignment of Solan- Shimla section of NH-22 by carrying out reconnaissance survey and recording observations. Based on these inputs the alignment has been finalised at site. The parameters are as under:

Table 5: Environmental Parameters and Observations

Environmental Parameters	Observations
Reserved/ Protected Forests	The project road passes through protected/reserved forest at few locations.
Project road alignment near river flood zone wet land, lakes, etc.	Project Road is crossing Few Nallas. Only one Nalla named Samri is perennial. No lakes or wet land along project road alignment. .
Significant groups of trees and orchards near the RoW.	Predominant tree species that generally occur within the proposed RoW are Deodar, pine, Kail, Chill, Khark, Quhl, Kachnar, etc. There are no endangered species of flora in the RoW. The alignment of does not pass through orchards. Dense plantation and giant trees in the RoW have been avoided while finalizing the widening schedule. The tunnels have been proposed to avoid forest land acquisition.
Historic structures, monuments and cultural heritage structures	The alignment avoids all cultural and heritage sites.
Settlements (towns and villages) and market places	About 16 nos. habitations of various sizes are nearby to the right of way. Bypasses are proposed to avoid the major settlements and markets of Shogi, Shimla, Dhalli and Kandaghat.
Wetlands close to RoW	The alignment does not cross any major river. No wetland is present close to the project road. The alignment crosses only three land drains.
Flora , Fauna and other endangered species	No endangered species of flora and fauna within the project right of way
Bird sanctuary, Wild life sanctuary and endangered areas	No bird sanctuary or wild life sanctuary within 10 km of the alignment.

River , canal crossings	The alignment crosses the local streams namely Kathulu Ka nallah, Kail Ka Nalla, Samri Nalla and Kalali Ka Nalla.

Table 6: Project Mitigation Measures for Project Affected Settlements

Stretch (Km)	LHS/ RHS	Nature and extent of problem	Mitigation Measures
109.000 to 109.400	RHS	Habitation on right side	Realignment proposed from LS
110.700 to 111.000	RHS	Habitated area	Realignment proposed from LS
112.400 to 112.800	LHS	Habitated area	Realignment proposed from RS
115.000 to 118.700	Both	Habitated area of Kandaghat town on both sides	Bypass Proposed
120.200 to 120.600	RHS	Habitated area	Realignment proposed from LS
121.000 to 121.400	RHS	Habitated area	Realignment proposed from LS
123.000 to 123.600	RHS	Habitated area	Realignment proposed from LS
128.700 to 129.400	RHS	Habitated area, Railway Station on right side	Realignment proposed from LS

Bypasses

The need for bypass around the congested towns along the project road was identified in consultation with the NHAI, PWD, and other stake holders. These identified towns are Kandaghat, and Shogi- Shimla- Dhalli. The existing road from Shogi to Shimla is surrounded by habitations such as Tara Devi, Kacchi Ghati, Tutikandi, Fagli, Lalpani, Vikas nagar, Kasumpti, Pantha ghati, Malyana, Mehli and Dhalli. Imrovement and widening in these localities is not possible due to massive R&R problem. Hence a combined bypass for Shogi – Shimla and Dhalli has been proposed.

Kandaghat Bypass

Kandaghat town is located between the chainages 115.000 to 118.700. The houses are located on both sides**.** Three options were explored. The description of the each of the option is clearly outlined.

- Starting at the km 115.200 and ending at km 118.700 on left : The left side option is not feasible due to deep valley Kalka-Shimla rail line Kandaghat Station and Habitation.
- Widening along the existing road : The enough RoW is not available. There will be massive demolition of residential and commercial structures.
- Starting at the km 115.200 and ending at km 118.700 on right: This option is most suited as vacant land and terrain suiting for road construction is available.

Shogi- Shimla – Dhalli Bypass

The project road from Shogi Dhalli by Shimla passes through many congested habitations such as Tutikandi, Fagli, and Lalpani, Khalini, New Shimla, Vikas nagar, Kasumpti, Panthaghati, Mehli, Malyana and Dhalli. The three options explored were widening along the existing alignment , a bypass from right side before Shogi town and ending after Dhalli, and a bypass on left side starting before Shogi and ending at Dhalli.

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- Starting at Km 131.150 and ending at km 156.000. : on right side None, as terrain is suitable for road construction and appreciable Government land is available. The villages are also not much this side.
- Starting at Km 131.150 and ending at km 156.000. : on Left side Because of habitations on left side, this option would have resulted in more length and high cost. The valley towards left side is deep and steep. Hence this option is not feasible from engineering considerations.
- Widening along the existing Road : This option is not possible due large settlements all along the project road. This will result in huge demolition of houses and structure. This option was rejected by the authorities and locals.

CONCLUSION

- The analysis of the alignment for the project road widening from Solan to Shimla along with Shogi – Shimla – Dhalli bypass and Kandaghat bypass indicates that the environmental considerations have been given due weightage in the finalisation of the alignment.
- **No environmental sensitive features** such as Notified Wildlife Parks, Bird sanctuaries,Notified Wetlands **are within 10 km** of the proposed alignment.
- Since the project alignment passes through a number of habitations, it has been finalised by proposing either realignments or bypasses at critical areas to minimise negative social impacts on the local population due to land acquisition or demolition of structures and to avoid orchards and cluster of trees.

PROJECT BENEFITS

REDUCTIONS IN OPERATION COST

Vehicle operating cost will be reduced when riding quality of road is good. Maintenance and Operation cost such as fuel consumption, wear and tear of tyres, will be sufficiently reduced. The vehicle operating cost shall be further reduced by improved geometrics and design. The benefits to the road user are in the form of lower expenditure. VOC consist of the following components:

- Fuel Consumption;
- Lubricating oil consumption;
- Spare part consumption and repairs
- Tyre consumption; and
- Vehicle depreciation.

REDUCTIONS IN ACCIDENTS

The proposed improvements of NH-22 will reduce congestion in built-up areas along the project road such as Solan, Shimla, Dhalli, Kandaghat, wakanaghat, New Shimla, Vikas nagar, Mehli, Panthaghati, etc. The distance between Dhalli and Solan will be reduced by about 16 km. The accidents will reduce in these habitations as well as on the existing NH - 22 portions from Solan to Shimla.

In order to make the project road accident free road signage and safety features have been planned at the design stage. Required lighting shall be provided at the locations of Toll Plaza, ROB, Tunnels, and sharp curves and other critical location to avoid accidents during night in adverse climatic conditions.

TOURISM DEVELOPMENT

The project road provides access to Shimla, Kufri and other destinations in the region. Hence project road 4 laning will further enhance tourism potential of the Shimla and surroundings.

ECONOMIC DEVELOPMENT

Road development program can contribute to economic development by encouraging attraction of businesses to sites equipped with good access and by improving the travel efficiencies of existing businesses and to start new avenues. They also help for:

- The development of new project sites,
- The development of Hotels, restaurants and Resorts,
- Infrastructure projects, and
- Development of IT parks.

EMPLOYMENT OPPORTUNITY

The project like any other road development project will serve as an important employment generator and will provide employment opportunity during construction phase. In postconstruction phase industrial and infrastructure development will provide enormous employment opportunities.

DEVELOPMENT OF AGRICULTURE

The immediate impact area of the NH-22 (Solan- Shimla section) has good fruit and vegetables producing area.. Improvement of the road will help the farmers in getting good prices of their product by quick and fast transportation of goods to the market places at Kalka, Ambala, Chandigarh, Delhi and Punjab.

INDIRECT BENEFITS

In addition to direct positive impacts, a large number of indirect benefits are also attributed to 4 laning of project road section from Solan to Shimla. Lowering transportation cost & time duration for users and improving access to goods and services enables new and increased economic and social activity. Individuals, households and firms adjust to take the advantage of those benefits, leading to several indirect impacts over a period. These indirect impacts include changes in land use and development, changes in decision to locate houses and business in areas where houses and land are less expensive or more desirable, and changes in warehouse and delivery procedure for businesses in order to take advantage of improved speed and reliability in the transportation system. These impacts further lead to increased property values, increased productivity, employment and economic growth.

ENVIRONMENTAL BENEFITS

Reductions in adverse environmental impacts of transportations i.e. reduced emissions; decrease in Respirable Suspended Particulate Matter and Suspended Particulate Matter, reduced Noise and other impacts are also the direct benefits of the proposed 4 laning of Solan – Shimla section of NH-22.. These benefits will also be felt within the major habitations as bypasses have been proposed at the congested locations.

SUMMARY AND CONCLUSION

INTRODUCTION

The Ministry of Road Transport and Highways (MORTH) on behalf of Govt of India engaged in the development of National Highways through the Govt body represented by National Highways Authority to develop the National Highways under NHDP (National Highways Development Programme). As a part of Endeavour the National Highways Authority of India has decided to under take 4 -laning of section from km 106.000 to 156.000 of NH-22, from Solan to Shimla(including Shoghi- Shimla bypass. The section of NH-22 lies in the State of Himachal Pradesh connecting to state capital Shimla to Solan and further down cities of Kalka, Chandigarh, Ambala and Delhi, passing through various industrial and commercial places. The project road length is 50.507 km.

IMPLEMENTING AGENCY

The National Highways Authority of India (NHAI) is the implementing agency of the project.

PROJECT LOCATION

Shimla and Solan are two important cities of Himachal Pradesh. The NH-22 connects Solan to Shimla and this highway also provides connectivity to Kalka, Chandigarh, Panchkula and Ambala in the plain land. The project road passes through two districts namely Solan and Shimla. Project road starting point is Solan (km 106.000) and the termination point is near Dhalli (km 156.000). The project road from km 106.000 to km 132.230 runs in Solan district, from km 132.230 to 156.000 in Shimla district. The total length of the project road is 50.507 km. Entire project road length is located in the state of Himachal Pradesh.

PROJECT DESCRIPTION

The existing road is two-lane configuration. It is planned to widen this road to 4 lane configurations with geometric improvements for free flow of traffic.

The road passes through 16 major settlements, which do not have sufficient RoW to be widened to 4 lane facility hence 2 bypasses for Kandaghat, Shoghi- Shimla-Dhalli (for Shogi, Tara Devi, Kachhighati, Tutikandi, Fagli, Lalpani, New Shimla, Panthaghati, Mehli, Malyana and Dhalli) have been proposed to avoid these congested settlements and to facilitate uninterrupted movement of traffic. The proposed improvement will aim at improving riding quality and journey speed and reducing traffic congestion on the highway.

The options of concentric widening and left or right side widening has been considered for the improvement project so as to utilize the existing right-of-way (RoW) as far as possible and minimize acquisition of additional land. However, land acquisition will be required through entire stretch as the existing RoW varies only between 12 m to 30 m.The total cost of the project has been estimated about Rs. 1786 crores.

DESCRIPTION OF ENVIRONMENT

The description of the environment as discussed above**.**

IMPACTS AND MITIGATION MEASURES

The potential impacts and their mitigation measures as discussed above.

ANALYSIS OF ALTERNATIVES

The analysis of alternatives for the project road was carried out for "With Project Scenario" and "Without Project Scenario". For realignment and bypasses 3 options have been evaluated and option having minimum environmental and social problem has been opted. The widening schedule has also been finalised to minimise tree cutting in the existing RoW and to have minimum impact on properties.

BENEFITS OF THE PROJECT

The project will have multiple benefits. It will reduce the travel time substantially between Solan and Shimla. In addition the improved road will provide other benefits like

- Fast and safe connectivity resulting in savings in fuel, travel time and total transportation cost to society;
- Employment opportunity to people;
- Development of local industry, agriculture and handicrafts;
- Development of tourism and pilgrimage;
- Transporting processing and marketing of agricultural products;
- Reduction in accidents;
- Reduction in pollution;
- Opening up of opportunities for new occupations;
- Better approach to Medical & Educational services and quick transportation of perishable goods like fruits , vegetables and dairy products; and
- Improved quality of life for people and so on.

CONCLUSION

The proposed project will have multiple benefits in terms of economic development and fast connectivity. All environmental impacts identified and assessed are manageable to acceptable levels by implementing environmental management plan.

ANNEXURE

Figure 5 : Project location and Alignment on Google Map

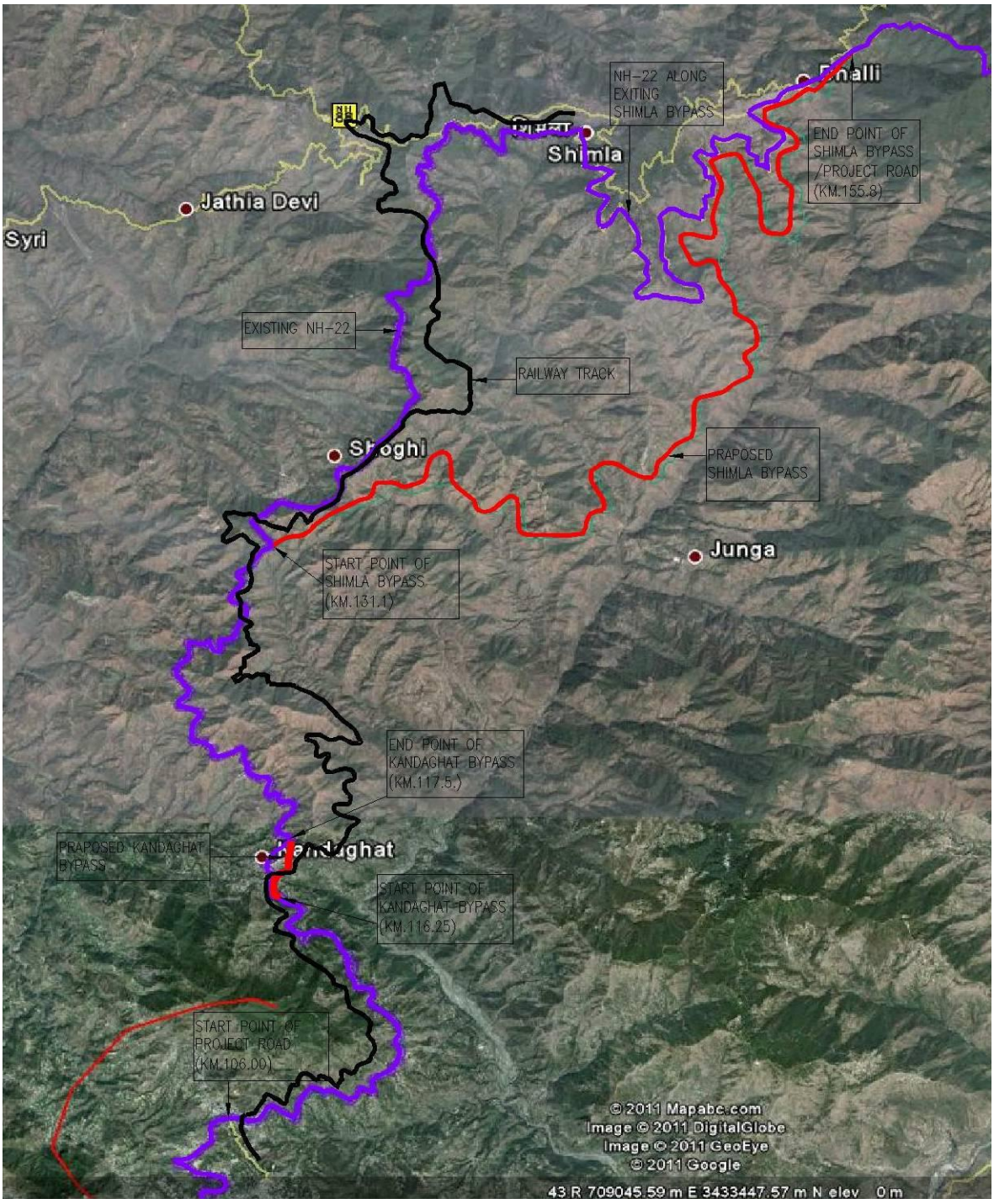


Figure 6 : Locations Of Water Quality monitoring

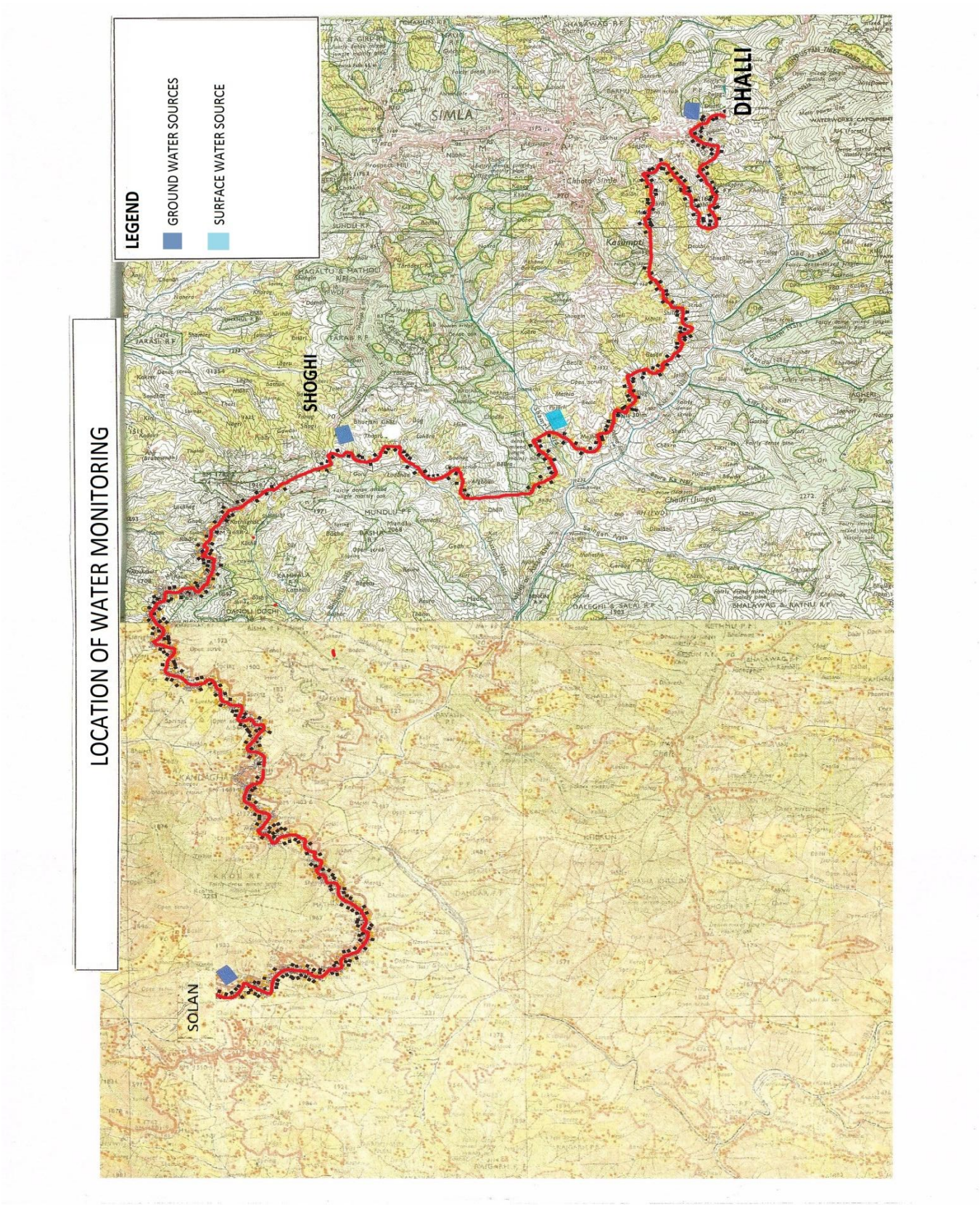
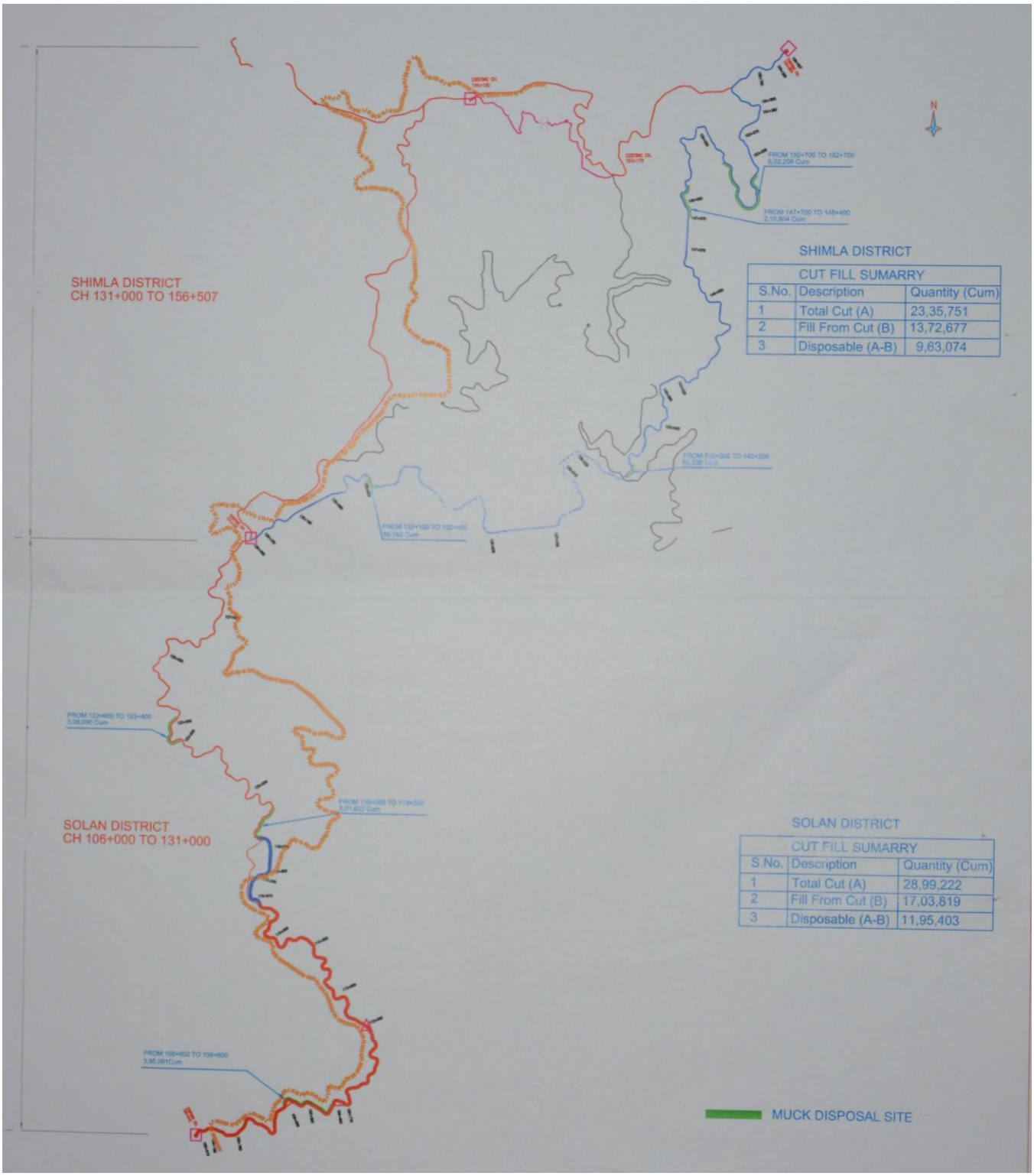


Figure 7: Key plan Solan Shimla NH-22

Figure 8: Muck disposal site



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